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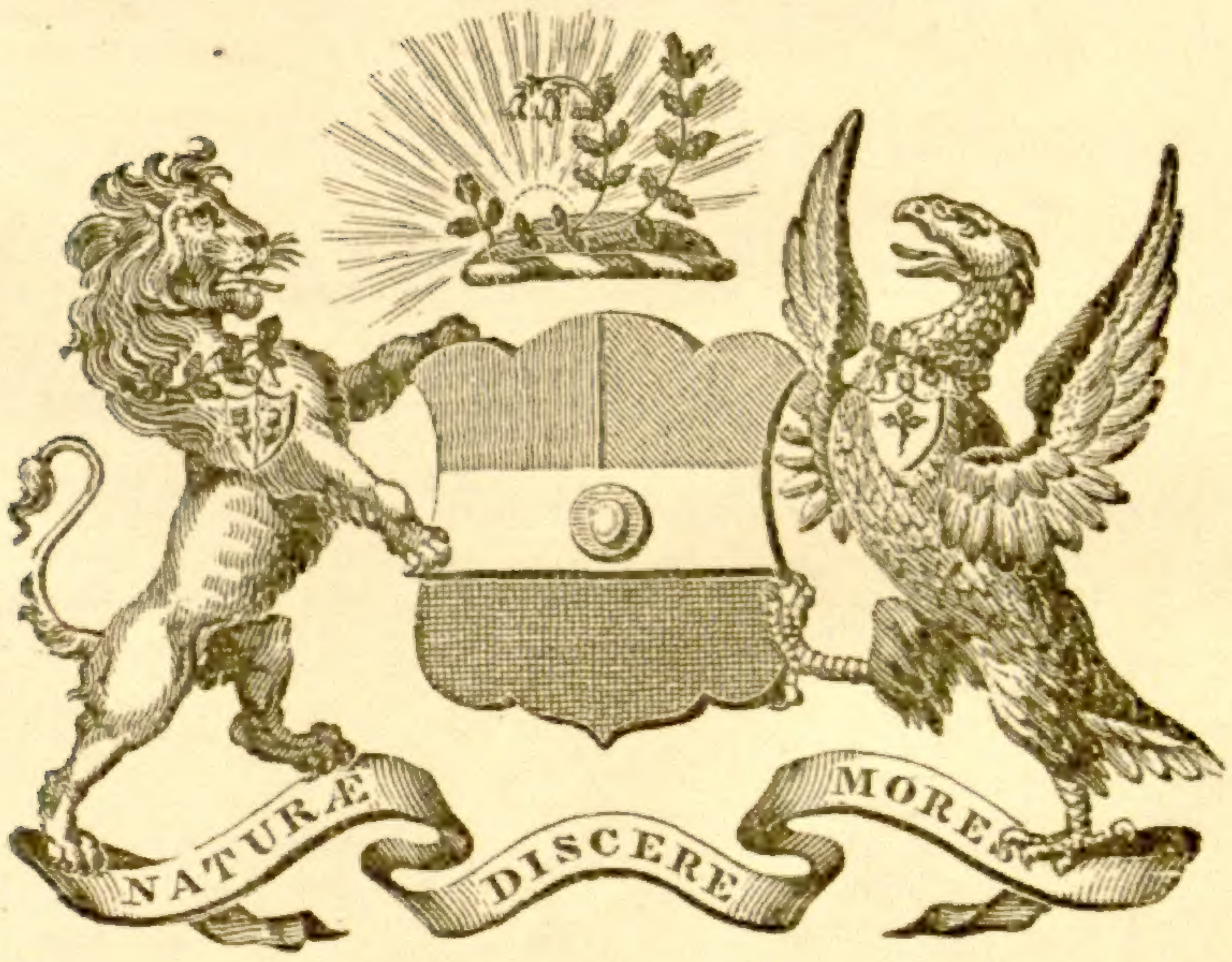

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2nd Ser. BOTANY.] [VOL. V. PART 1.

THE TRANSACTIONS OF THE LINNEAN SOCIETY OF LONDON.

MONOGRAPH OF THE ACETABULARIEÆ.

BY

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June 1895.

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THE LINNEAN SOCIETY.

I. *Monograph of the Acetabularieæ.* *By* Hermann, Graf zu Solms-Laubach, *Professor of Botany, University of Strassburg, Foreign Member of the Linnean Society.*

(Plates I.–IV.)

Read 19th April, 1894.

THANKS to the work of Nägeli, Woronin, de Bary, and Strasburger, the structure and development of the European species of *Acetabularia* are tolerably well known, and about no other type of Dasycladeæ does there exist so rich a literature. Woronin and de Toni have sufficiently treated of the older literature occupying a standpoint which we may now consider left behind us. Leitgeb has minutely investigated the rich inuline contents of the plant; the same author has made the cell-membrane and its incrustation the subject of a critical treatise; and the other forms of Dasycladeæ have recently been repeatedly studied by Agardh, Cramer, and myself. However, a comparative examination of the genus *Acetabularia* and its nearest allies from the systematic point of view has always remained a desideratum, though serviceable preliminary treatment of it has been furnished by Kützing, Harvey, Agardh, and Cramer. Since the systematic study of *Acetabularia* provides a foundation for palæophytological work I have been the more attracted to it, and will submit the results of my examination into this side of the subject in the following pages. If I have attained anything having a claim to general interest I must attribute it first of all to the great liberality and kindness with which valuable material has been made accessible to me. I have been able to examine the *Acetabularieæ* of the British Museum, of the Kew Herbarium, of the Herbarium of Thuret, of the Berlin, Göttingen and Strassburg

Museums, and the original specimens of Beccari's collection at Florence. Single species were sent to me by Professor Perceval Wright, Professor Agardh, Dr. Schenck, and Professor Farlow, and I wish to express my indebtedness and thanks to all who have thus aided me.

Of living *Acetabularieæ* there have been described three genera: viz., *Acetabularia*, Lam., *Polyphysa*, Lam., and *Halicoryne*, Harv., with which Sonder's genus *Pleiophysa* is identical. To these are to be added the fossil forms established by Munier-Chalmas and the genera placed here, *Acicularia*, d'Archiac, *Briardina* and *Orioporella*, Mun.-Chalm. Of the two latter genera (not yet fully described) *Briardina* comes very near to *Acicularia*, as I know from a kind private communication of its author ; *Orioporella*, however, does not belong here at all, as he has recently convinced himself, and therefore needs no farther mention.

According to de Bary and Woronin's description the fertile pileate shoot of *Acetabularia mediterranea* consists of the stalk, with its foot grasping the substratum; of the basal portion, immersed in this; and of the cap, which is partitioned by regular radial walls into chambers, which are in open communication with each other only in the middle, above the insertion of the stalk. This central flat area, covered with a level circular membrane terminating the apex above the insertion of the stalk, may be called the central area. It is surrounded by a continuous, circular, convex cushion, which I shall call the *corona superior*, belonging to the chambered marginal portion of the disc. The corona superior is farther composed of numerous firmly united radial sections or areas, the rays of the corona. Each of these radial areas bears a radial row of circular protuberances, or scars, which correspond to tufts of hairs that have fallen off or have remained incompletely developed and one-celled. The number of these scars varies. Cramer gives them as 4 to 5, though higher numbers may well occur. Where the hairs are complete they belong to the outer parts of the row in question. On the under side of the cap there are present, according to de Bary and Cramer, two concentric cushions surrounding the insertion of the stalk. The outer, more peripheral of these corresponds exactly with that found on the upper surface and may be called the *corona inferior*. It also is composed of exactly as many radial areas as there are chambers in the margin of the cap, but the hair papillæ are wholly absent. The more central cushion, adjoining the stalk, is not sharply separate from the other, but gradually becomes merged in the central area. The peripheral one consists of what may be called the vestibules of the chambers of the cap, of which there is one for each chamber, but separated by a fold of the membrane like a transverse septum, which within shows only a small opening, frequently becoming obliterated by subsequent growth in thickness. While, therefore, each disc or sporangial ray stands in open communication with the relative sections of the corona superior and inferior, it is separated from its vestibule by the membrane described with a central perforation. The corona inferior and vestibules were first correctly described and figured by Cramer for *A. crenulata*.

We have, then, in the middle the central area, into which open the narrow vestibules, adjoining, but separated from each other by a thick membranous process. Next there is the peripheral crown of radial chambers, firmly united to each other

laterally, and separated from the corresponding vestibule by a wall perforated in the middle. Each one of these chambers consists of the basal portion, which bears a segment of the corona superior and inferior, and runs out between both in the direction of the radius into the sporangial ray. In *Acetabularia mediterranea* there is no sharp limit between basal portion and sporangial ray *, and both pass imperceptibly into each other with an open lumen. But we shall see that this varies in allied forms, as may be seen in the description of *A. Peniculus*. Characteristic of our species is the firm union of the radial chambers already described; it extends to all parts of them and reaches the outermost margin, so that this appears as exactly circular as if cut out. The upper corona is bounded on the outer side by a simple circular line; in the lower the single chambers bulge somewhat outwards, so as to give a wavy contour, which is added to by the unusual thickening of the sections of the membrane †.

In the ripe cap-bearing shoot the whole contents of the disc are used in the formation of the egg-shaped spores, the peculiar formation of the membrane of which was represented more correctly by de Bary and Strasburger than by Woronin. At one pole of the spore the circular lid, which resembles a cone-valve inserted into the membrane from within, is situated as in *Neomeris*; its contour lines on both sides in an optical section of the spore consequently converge a little outward. De Bary states correctly that the moderately thick spore-membrane shows stratification, and consists of an outer thicker layer and an inner thinner one of different capability of swelling up. He has established that both layers are formed of cellulose, easily rendered blue and completely soluble in SO_4H_2, but that on the surface of the spore there is found a tender cuticle-like pellicle, which stains yellow with iodine and withstands sulphuric acid, but remains over after treatment of the spore with concentrated acid in the form of a crumpled sac, when the whole internal portion has been completely destroyed. There will be a farther opportunity, in describing the genera *Chalmasia* and *Halicoryne*, of returning to the very complicated and peculiar structure of the membrane of the spores of *Acetabularieæ*, since the spore-membranes of these genera are much better adapted to investigation than those of species of *Acetabularia* on account of their greater thickness.

Woronin had already observed this cuticle-like lamella, and he states that it is the first thin membrane which the primordial spore forms on its surface. The cellulose layers are consequently differentiated immediately afterwards as the second proper cell-membrane. This point, as well as the development generally, deserves fresh investigation, which ought to be carried out under conditions of time and place unfortunately impossible for me, since they involve the summer months. Nevertheless, I will now briefly indicate the points for such revision and the question concerning it, in order that other botanists, of Italy or the south of France, who always have access to the plants, may have their attention drawn to them. According to Woronin there appear in the

* The lumen of the latter is only somewhat narrowed towards the point of contact.

† Woronin's figures, in Ann. Sc. Nat. sér. 4, tome xvi. pl. 9, are, so far as they are concerned with the structure of the cap, somewhat diagrammatic, but in the main correct. His pl. 9. fig. 4 shows the central opening in the membrane dividing vestibule from ray as too wide, and this division itself as a simple fold of the common membrane. Compare the figure in this memoir, Plate I. figs. 7, 8.

homogeneous chlorophyll-bearing protoplasmic layer of the sporangial ray small, completely colourless, round spots, about which the protoplasm gathers as about attraction centres. De Bary, who cites these spots, says (9, p. 719) "each spot appears to be a centre of attraction for a portion of the protoplasm, and may therefore well correspond to a nucleus." This appears to me to rest on a misunderstanding of Woronin's statement. Since, as his drawings show, these clear spots remain continuously well defined up to the complete rounding off of the spores, they cannot well be in the centre, but must rather be towards the outside of the young spores (compare Woronin's figures, pl. 6. figs. 1–5); in figs. 4 and 5 there is at the periphery of the primordial spore a shallow excavation, and Woronin says expressly "en examinant plus attentivement la structure de ces corps elliptiques on voit qu'ils ne consistent qu'en un sac primordial, qui a à sa surface une petite cavité, ou, ce qui est même probable, une ouverture." There can scarcely remain any doubt that this cavity represents the profile view of the clear spot, the filling up of which with colourless protoplasm the author had not sufficiently taken into account, although he has drawn it in fig. 4 in the form of an outline running over the excavation. Should it indeed be so, then the point ought to be farther enquired into whether the clear spot contains a nucleus, or whether these are to be found in numbers distributed throughout the protoplasm, as *a priori* appears more probable. We know from Schmitz's investigations that in the chambers of the disc of sterile plants of *Acetabularia* there are present, together with numerous small chlorophyll bodies, a large number of very small nuclei, which are much smaller than the chlorophyll grains among which they are irregularly distributed. He then continues:—"In the formation of the spores and zoospores there have been repeatedly observed, as is known, clear spots which doubtless represent nuclei. Their size, however, is far more considerable than that of the very small nuclei in the cap of the sterile plant, and their number much less. There must take place before spore-formation various processes in connection with the nuclei of these plants, perhaps conjugations like those recently described by Berthold for *Derbesia*." He takes accordingly precisely the position of de Bary in his interpretation of the clear spots.

I believe I have seen these minute nuclei in the protoplasm of the stalks of preserved material of *A. mediterranea*, and would even assume that they are to be found in the layer next the wall of the spores among the amylum granules; but I certainly cannot express myself on this point with complete definiteness because I could not, among the many difficulties presented by this plant, succeed in obtaining an undoubted nuclear stain with any staining agent.

While I must thus leave the whole question of the nucleus and its elucidation to future observers, I should like to call attention to the possibility of explaining the whole body of facts in the following way. The peripheral clear spot of Woronin's figures recalls in a striking manner the colourless protoplasmic portion which bears the cilia of an ordinary Confervaceous zoospore. If one now assumes that there is here a true homology, then the cap would correspond to a true zoosporangium of which the zoospores no longer develop cilia and do not escape, but rather surround themselves with a membrane at the place of origin, and enter at once into a resting stage, as indeed happens elsewhere

among Algæ, *e. g.* in the formation of the *polyhedra* of *Hydrodictyon*. After a lengthened rest these spores then give rise to the sexual generation of gametes described by Strasburger *.

The formation of resting spores would then be merely shunted to another point of the life-history. We know from de Bary, moreover—and the same takes place in *Dasycladus* according to my observations—that the zygote, after coming to rest, immediately grows out in the form of a cylindrical tube. De Bary could not obtain the normal development of this in his cultures of *Acetabularia*, but he was able to establish, from specimens collected in the open, that it first forms a basal vesicle as a store for reserve-material, that it then becomes strengthened by repeated diaphysis from this part which remains after the dying of the upper part, and grows into a small plant provided with several whorls of branched hairs. After an uncertain number of diaphyses, the apex of the stalk invested with whorls of hairs arrives at the formation of a cap, which closes the development of the plant with the formation of spores. One finds clearly marked on the stalk of each fruiting specimen, below the terminal cap and at some distance apart, especially after decalcifying it, several whorls of circular scars where the tufts of branched hairs, now fallen off, were formerly situated.

As regards the development of the complicated structure of the cap there are few observations before us, and these incomplete. However, even so, they show that the marginal chambers of the cap do not arise as so many separate projections like the hairs of a whorl and subsequently unite, but that the whole margin of the cap first makes its appearance in the form of a continuous cushion below the arched apex of the shoot. With its first formation there coincides that of the chambers and the closing of them towards the vestibules, so that, as I have seen in my spirit-material, they are completely developed when the cap is still in a young state. I have represented in Plate I., figs. 4, 8, 12, such young stages of the cap in lateral view from the outside and in section. From the outside it appears like a flat, projecting, arched band, bordered above and below by a sharp circular furrow dividing the sectional views of the walls of the chambers by numerous perpendicular lines into almost rectangular areas adjoining each other. Each of these partition-walls corresponds at the stalk end of the band to a line running gradually downward—the projection of the inward fold of the membrane separating off the vestibules. The longitudinal section (Plate I. fig. 8) shows that these vestibules are completely formed, and that the folds separating them at the inner margin are frequently strengthened and irregularly thickened. From the central area the margin of the cap appears to be completely separated by the partition, a simple fold of the membrane perforated in the middle. On the other hand, all the differentiations of the wall of the cap are still absent, the outer limit of the chamber seen in section is simply convex, or shows at most a slight depression in the highly arched central portion, where the membrane also shows itself weaker. The whole cap-chamber is completely filled with dense protoplasm without vacuoles. The shallow cavity becomes more pronounced with farther growth,

* They would represent the rudimentary sexual generation of the plant and be partly male and partly female, as is expressly stated by Strasburger. With reference to such a view I am in complete agreement with Falkenberg [11, p. 270].

so that the chamber is eventually bilobed (Plate I. fig. 4). The upper of the two lobes is the corona superior, from which the young hairs at once begin to grow; the lower gives origin to the corona inferior, at the upper margin of which the sporangial ray springs from the basal portion. And since all these processes of development go on in exactly the same fashion in the neighbouring chambers they remain in close connection and form themselves into the marginal region of the disc.

Harvey has given beautiful representations of the habit of the delicate *Acetabularia* (§ *Polyphysa*) *Peniculus*. The long calcified stalk, provided with a foot at the base and bearing a cap at the apex, is furnished at intervals with small nodular swellings, each of which bears a crown of circular scars, the points of insertion of a whorl of hairs. Cramer found these still *in situ* on certain specimens, and I also have seen them. But the disc consists of a variable, relatively small number of rays, which are quite free from each other and attached at the base to a small lateral projection of the central portion. Each such ray corresponds to a chamber of the margin of the disc of *Acetabularia mediterranea*, and adjoins, as in that case, a vestibule which forms a fold-like bend of the central portion—*i. e.* the projection described. On the ray the same parts are to be distinguished, but the differentiation of basal portion and sporangial ray is here much sharper. The latter has the form of an ovate-clavate, bladder-like swollen sac, with a rounded margin, and is connected with the almost cylindrical basal portion by its much narrowed base closed by a transverse wall. On the upper surface it bears a process somewhat broadened at its blunt apex and completely free all round, its particular part of the corona superior which shows on its apical surface 2 or 3 large broad scars of hair-tufts. These Cramer [5] at first overlooked, but subsequently [6] described on the whole accurately. When three scars are present they form a triangle with the base turned outwards, and when there are only two they stand obliquely behind each other, not straight as Cramer has said. A true corona inferior is wholly wanting, unless one follows Cramer in regarding as one the slight arching-out of the basal portion beneath. The calcification of the membranes is to some extent perceptible in the stalk only and is not present in the rays of the cap, or if so only as a very slight surface incrustation covering it all equally. The spores are of regular globular form, and otherwise on the whole similar in their structure to those of *Acetabularia mediterranea* (conf. Plate II. figs. 6 & 7).

Of the genus *Polyphysa*, thus distinguished by its wholly free rays of the cap and its globular spores, for a long time only two species were known, both from Australia, viz.:—*P. aspergillosa*, Lamour., and *P. Cliftoni*, Harv. An examination of Harvey's original specimen of the latter, which I was enabled to make by the kindness of Prof. Perceval Wright, resulted in the view that at the most this form may be regarded as a variety of the other with somewhat longer, more blunt, more clavate, and less swollen sporangial rays, but in all other points in exact agreement. Besides, in examining numerous specimens of *Acetabularia Peniculus*, caps are sometimes found which show an approach to the Harveian form. The sporangial rays of the original are entirely without lime, and filled with collapsed spores (from this cause polygonal in form), to which the thin sunken sporangial membrane has become so closely pressed that it appears crumpled. The same thing is to be seen in herbarium specimens of the normal form which have been very slightly calcified.

There are described in this paper several species which, from their characters, approach *Acetabularia Peniculus*, although sufficiently distinct from it. They want, however, so far as I could observe, the transverse wall between the basal portion and the sporangial rays, and they differ farther in the form of the latter, which, for example, in my *Acetabularia exigua* (Plate II. figs. 1 & 4) are somewhat cucumber-shaped and concave above, and in the number and arrangement of the hairs on the parts of the corona superior. Moreover, many of them, e. g. *A. parvula*, n. sp. (Plate II. fig. 5), *A. polyphysoides*, Crouan, show a difference in the mode of calcification of the rays of the cap, which in these instances is not equal all round, but much more abundant on the side-walls adjoining each other, and is often present there only, so that the spaces between the rays are filled with lime and bind them together with the appearance of a closed disc. There would be very little, therefore, against the supposition, after this discovery in a mature state, of an actual development in the manner of *Acetabularia mediterranea*, in which the final dissolution of the rays held together only by the lime incrustation takes place by the swelling and destruction of the common middle layer of the partition-walls. If we learn from the latter species how little weight is to be attached to these characters for a generic separation of *Acetabularia* and *Polyphysa*, this appears clearer than ever if we pass such a series of species in review as I have placed in the section Acetabuloides, and contrast them with our one European species forming the section Acetabulum. The best known forms of this series are the nearly related *A. crenulata* and *A. caraibica*, Kütz., round which a number of other species are grouped. In *Acetabuloides* the corona superior and corona inferior are developed in the same way as in *Acetabulum*, but their parts are not continuous with others laterally, are, on the other hand, smaller than the basal portions of the rays, and present knobs or processes completely free all round, although often closely adjoining. It is remarkable that this character has been overlooked by all authors who have dealt with the genus.

Woronin says [31, p. 201], " Dans le 4trième tome (1856) des 'Tabulæ phyc.' Kützing décrit et représente une nouvelle espèce de l'*Acetabularia*: *A. caraibica*; mais cette espèce, à ce qu'il me semble, ne diffère en rien de l'*Acetabularia mediterranea*"; and Cramer, who is otherwise so accurate, says [5, p. 24]: "The caps of *A. crenulata* are provided above and below with collars, and the upper appears to differ in no respect from *A. mediterranea*." All have observed that the connection of the sporangial rays in *Acetabuloides* does not reach to the outermost point, and that in consequence the margin of the disc appears toothed or notched. Agardh was the first to found on this point a division of the genus into two sections, which agree exactly with mine, although more precise knowledge of the distinctive characters was then wanting.

In regard to the firm lateral connection of the sporangial rays, the forms belonging to *Acetabuloides* show differences. In none of these species is this union so firm as in *A. mediterranea*; indeed, two species are described — viz. *A. Calyculus*, Quoy et Gaimard (Plate III. figs. 6, 7, 10, 13), and *A. Farlowii*, n. sp. (Plate III. fig. 1),—which in the complete separation of their rays come very near to *Polyphysa*, from which they are to be distinguished only by the presence of a well-developed corona inferior. In most of the species, certainly, the rays remain, after decalcification, more or less united laterally

by a slimy, soft substance, which opposes little resistance to a dissecting needle, and is often so soft that its consistency is destroyed by the evolution of gas in the action of the acid. In how far this substance represents the swollen middle lamella of a circular cushion of united chambers originally closed like *Acetabularia mediterranea*, or wholly or in part the cohesive product of the disorganization of the outside of the originally free walls of the ray as in *Polyphysa*, cannot be certainly determined without a knowledge of development unobtainable from dry material. Be this as it may, in any case *A. Calyculus* and *A. Farlowii*, in all other respects true *Acetabulariæ*, agree in this point in the mature condition with *Polyphysa*. There is otherwise such a series of intermediate cases that this character does not maintain any systematic significance. For this reason I have thought it right to sink the genus *Polyphysa*, distinguished only by the absence of a well-developed corona inferior, and to regard it as only a section of *Acetabularia*.

Acetabuloides appears to include numerous species falling under several groups within which they are to be distinguished only with difficulty. A definite elucidation of all these forms is not possible on the basis of the generally meagre specimens preserved in herbaria. Various doubtful specimens have consequently not found a place in this paper. The classification given here is less concerned with the natural relationship than with an attempt to attain a ready key to the naming of species. Otherwise *A. Farlowii*, n. sp., and *A. Suhrii*, n. sp., would probably have been brought nearer to the group of *A. crenulata* and *A. caraibica*; while *A. dentata*, n. sp., would be separated from it. *A. Calyculus*, Quoy et Gaim., would be isolated, and the three species distinguished by the size of their caps, *A. Kilneri*, J. Ag., *A. major*, Mart., and *A. Gigas*, n. sp., would form a natural group. In these three species the radial walls dividing the chambers of the cap show a common peculiarity first noticed by J. Agardh in his *A. Kilneri* (Plate I. fig. 6). The section of the radial wall shows a broad, soft, slimy middle layer, and two coarse layers bordering the lumina of the chambers. These show perpendicular stratifications irregularly distributed, but often in groups, passing out towards the slimy middle layer and not towards the lumen, and sometimes alternating with each other like notches. If one tears the chambers apart to view these stratifications from the surface, it appears that they are not equally developed over the whole surface of the wall, but most strongly at the upper and lower margin, decreasing, flattening out, and vanishing imperceptibly towards the middle. Plate I. fig. 6 *a* shows them in normal position from one side of the surface of the cap; Plate I. fig. 6 *b* in oblique surface view obtained by pressing asunder the two lamellæ.

Enough has been said to lay a foundation for the appreciation of the genus *Acetabularia* as understood here. A peculiarity is to be mentioned, however, which occurs only very rarely in other species, but appears to be characteristic of *A. crenulata* in its normal development, viz.: the shoot, after forming the first cap, grows through it and produces several others in succession. Specimens of this species are common enough with several caps of unequal development above each other (Plate I. fig. 1); very often only the uppermost remains, and thick nodular swellings, with scars, show the places on the stalk where former caps have fallen off. Between every two of such caps there is a whorl of

dichotomous sterile hairs, and if they have fallen off, the scars likewise remain on much smaller swellings of the stem. This regular alternation of cap and whorl of hairs was excellently illustrated by Harvey [12, p. 40], and later described by Cramer [5, p. 24].

The scars of the whorl of fallen hairs are easily distinguished from those of the cap. While they have the form of broad oval figures, not touching each other, with a point in the centre—the original opening now closed up—those of the disc-chambers are pressed together laterally, elongated, and marked with a narrow central perpendicular slit. In order to explain the mode of origin of this very peculiar appearance I examined such caps as were over-ripe and beginning to disintegrate. This resulted in the observation that the breaking-up was caused by the splitting of the partition-wall between the vestibule and the basal portion of the cap-chamber, but that simultaneously (through a farther thickening of the membrane of the stalk) a deeper division is attained in which the new lamellæ, produced by apposition, cut off transversely and bridge over the cavity of the vestibule. It is the lumen of the vestibule, thus cut off and much narrowed laterally by thickening, which, after the decay of the lamella originally covering the partition, appears in the form of the perpendicular slit described. Since I had only a small amount of material of *Acetabularia crenulata* suitable for determining this question, I was unable to follow out the stages in the cutting off of the vestibules; in all the caps still *in situ* which I examined there was nothing of this to be found. I have never observed this peculiarity at least in typical specimens of *A. caraibica*, in every point nearly related to *A. crenulata*; Kützing's *A. caraibica*, var. *calyculata*, of which this is the distinguishing point, is probably only the true *A. crenulata*.

The possession of several successive caps on the same shoot is otherwise a rare anomaly in the genus. Exactly this condition of *A. crenulata* was found on a specimen of *A. Calyculus*, Quoy et Gaimard, by Askenasy. On another shoot of this species the same author found two successive caps separated by several hair-whorls. They have been observed by Bornet and Woronin in a few specimens of *A. mediterranea*, and by myself in a single specimen of *A. Möbii* (Plate IV. fig. 1). But in the latter case it differed from *A. crenulata* in that the two caps were immediately one above the other without the intervening whorl of hairs. How it would be in this respect in the case of *A. mediterranea* I have been unable to decide from lack of material.

Let us now examine the genus *Acicularia*, d'Archiac, which has been hitherto known only in a fossil condition. It was established by d'Archiac on small longish bodies, pointed at one end, broad and emarginate at the other, found in the Paris Eocene, which consist of calcium carbonate and are surrounded with numerous cavities opening outwards. Both d'Archiac and Michelin referred them to the Bryozoa, and Reuss at a later date did the same, while Carpenter placed them among the Foraminifera. To the original species *A. pavantina*, d'Archiac, Reuss added another similar form from the Austrian Miocene, viz. *A. miocenica*. The circumstance that these lime-spiculæ were occasionally found together radially disposed, and that the remains of radial partition-walls were to be recognized, led Munier-Chalmas to remove them from the animal kingdom and, with rare divination, place them with the *Acetabularieæ*. This conjecture, which had little to

support it in the fossil material, has been more recently proved true in the most brilliant fashion by the discovery of a living species of this genus. Of this species I found first specimens from Martinique in the Berlin Herbarium, then several from Guadeloupe in Herb. Thuret, but later I found that it had been described as *A. Schenckii*, Möbius, from specimens gathered by Dr. Schenck, at Cabo Frio in Brazil. I was unable, however, to satisfy myself of this determination until I had received the original specimens from the discoverer. Nothing was to be made of the description of the plant, which did not mention the principal peculiarity. The cap-bearing shoots of *Acicularia Schenckii* (Plate III. fig. 14) agree in all essential points of external structure with those of *Acetabularia*, section Acetabuloides. Their sporangial rays are rather closely united; the coronæ superior and inferior are well developed and agree in form with those of *A. caraibica.* While the sporangial rays of Acetabuloides contain numerous round free spores, in this plant each ray contains a small body that exactly corresponds in form and structure with the lime-spiculæ described for *Acicularia.* It consists of a strongly calcified substance enclosing numerous cavities lying near the surface, and consequently transparent. In each of these and completely filling it there is a spore of the same structure as those of *Acetabularia* (Plate III. figs. 9, 15). It follows that the pits of the fossil forms are spore-containing cavities from which the spores have disappeared and the external lime-covering has not been preserved, so that they appear as opening outwards. If such a sporiferous spicula be treated with dilute acid, there remains as the substratum of calcification a slime of small consistency, which surrounds the spore-cavities and is quite homogeneous, showing no differentiation either superficially or internally, except that here and there among the spore-cavities and occupying exactly the middle there are triangular or quadrangular spaces. The spores themselves are globular, with a sharply outlined, rather thin membrane, provided with a lid in the usual way. In consequence of drying they have often collapsed in the form of a basin or dish, exposing a part of the spore-cavity, from which it may be inferred that in the mature condition they lie free within it. On treatment with sulphuric acid the membrane swells up exceedingly, and on its surface there appears a very delicate, tightly-stretched membrane, with a sharp contour, which finally bursts and sinks down folded up, proving to be a very delicate cuticle-like lamella (*cf.* Plate III. fig. 9). If we turn to the careful examination of the unaltered spicula in order to obtain a clear understanding of the origin of the slimy substratum of the calcification, we see that the lime-mass does not possess equal thickness at all places, but that each spore is surrounded as with a shell by a wall-like ring of maximum calcification. These shells appear to be stuck to each other by a slight lime-incrustation in the interstices, and the above-mentioned angular spaces, quite without lime, are to be found here and there in an unaltered state. A view of the whole gives the impression that the slimy substance has originated by a transformation of the outer layers of the spore-membrane, and that these are afterwards united into a firm mass by calcification. If the slime were the remainder of the protoplasm of the sporangial ray not used in the formation of the spores, as might very well be the case, then it would be impossible to understand why it is not evenly distributed, and why its density should decrease in so striking a way in the direction of radii from each spore. However, there is opposed to this view the circumstance that the membrane

of the enclosed spore possesses already its own cuticle-like outer lamella exactly as in *Acetabularia*, thus appearing completely closed externally. We should have to assume that this lamella gradually succumbs to the transformation into slime and is again renewed from the layers beneath, which is indeed the less impossible since the membrane in question does not represent a cuticle in the chemical sense of the word. We shall return to this point in describing the spore-structure of the genus *Halicoryne*. The tracing of the mode of development of the sporangial ray, which alone could give us more information on this point, was impossible owing to the state of the material.

The fossil form described by Andrussow as *Acetabularia miocenica*, Andr., which occurs, forming on rocks, in the Crimea, south of Sebastopol, in the ravine of Karanj, may be put with the genus *Acicularia*. But in this form there are not merely the spore-containing spiculæ, but whole caps, and their parts are preserved. From Andrussow's [2] description and figure I had thought of putting it into *Acicularia* even before I had received several fragments through the kindness of the author. The examination of this certainly scanty material has only confirmed me in my opinion. In fact it agrees with *Acetabularia* or *Acicularia* in external conformation as well as in its double corona, but whether the corona exhibits the characters of *Acetabulum* or *Acetabuloides* could not be determined from my material. The extraordinary strength of the chamber partition-walls is very striking, and it gives great consistency and hardness to the whole fossil. This is not shown in Andrussow's somewhat diagrammatic woodcut. Each sporangial ray encloses a free spicula formed like it and bearing the spore-cavities in four rows, of which two lie near the upper and two near the lower membrane, while in the middle and towards the chamber partition-walls homogeneous lime prevails. (Compare the surface view of the chambers containing the spiculæ, Plate III. fig. 13.) Round each spore-cavity there is a circular zone which stands out, when viewed in a reflected light, through its white colour against the central mass of the spicula, though a sharp contour is not visible. The calcification does not appear from Andrussow's statements to be so complete in all cases, for he says (§ 78) : " But sometimes the calcification appears to have gone farther, so that almost the whole cavity of the radial chambers is filled with lime and only small round holes remain corresponding to the cells. At least certain of the specimens from the Karanj ravine indicate this, and somewhat rubbed portions of such specimens show a certain likeness to the so-called *Acicularia* from the Paris Eocene." Such, at any rate, are the specimens I have seen. Nevertheless it is not to be doubted that the spores when the plant was alive were united in calcified spiculæ, perhaps of loose porous consistency. In the fossilization of spore-bearing uncalcified *Acetabularia* chambers the spores would probably be destroyed, and would certainly not be preserved with so sharp a contour of the interior and in so characteristic and regular position. Andrussow himself assumed a calcification of the living spore-wall. He says [2, p. 79] :—" Our alga is generally more calcified than the known *Acetabulariæ*, and it is still more distinguished from them by the presence of cells in the chambers, which has not been observed in any of the living *Acetabularieæ*. This circumstance, however, appears to me to be insufficient to warrant the removal of this alga to a separate genus. We know, indeed, that the radial chambers in a ripe state are filled with spores arranged, according to Woronin, in a spiral

line. The spore-membranes of our incrusted algæ might probably be calcified [a phenomenon not seldom observed in many other *Dasycladeæ*], and in this way give rise to the cell-formation mentioned." With reference to the words placed in brackets, Andrussow was not justified in their use, since, at the time he wrote them, *Acicularia*, *Chalmasia*, and *Halicoryne*, the only genera of *Dasycladeæ* with calcified spore-membranes, had not been investigated with reference to this point. Since the name "*miocenica*" has been given to another *Acicularia*, I must name afresh the South Russian fossils, and they may be called *Acicularia Andrussowii*.

Chalmasia antillana is the name by which I shall refer to a plant which I discovered in Herb. Thuret, represented by a few incomplete specimens collected by Agassiz in the West Indies. In habit it agrees with Acetabuloides, of which the disc-chambers are easily separable after decalcification. But it shows on closer examination the characters of *Polyphysa*; the corona inferior is absent. The free parts of the corona superior have a peculiar form and terminate in obtuse processes with two or three hair-projections. The calcification is slight and apparently confined to the outside of the membrane. On the sporangial rays there are irregular lime-scales, surrounded by furrows, lying on the outside of the membrane, and somewhat easily loosened with the help of a needle. The character of the genus is to be found in the spores. These are free as in *Acetabularia* and fill the sporangial ray with their irregular mass; they are provided with a thick, very strongly calcified membrane, and appear on this account, when seen with a pocket lens, as milk-white, not transparent globules. When these spores are decalcified they show first of all that their membrane, compared with the forms already mentioned, possesses extraordinary thickness, is beautifully and abundantly stratified, and surrounded by a definite, coarse cuticuloid layer. The locus of the lime-incrustation is to be found here in the layers themselves of the membrane, while those of *Acicularia*, where only the slime mass is calcified, are quite free from it. Again a lid of circular form and considerable diameter is present. It has, however, a somewhat different form and does not represent a cone-valve inserted from within, but rather it broadens towards the outside so that in optical section the two lateral bounding lines converge towards the interior, and do not diverge as in the other cases. Possibly this stands in connection with the remarkable thickness of the spore-membrane, which, if the lid were inserted as in *Acetabularia*, would necessitate a considerable increase in the volume of the spore to render its falling out possible. For the rest the spores agree down to the minutest details with those of *Halicoryne*, with which, however, *Chalmasia* could not be united owing to the wholly different structure of the shoot (comp. Plate III. figs. 2, 3, 5).

Of the genus *Halicoryne* there are two species known, viz. *H. Wrightii*, Harv., from the Loo-choo Islands and the Philippines, and *H. spicata*, Kütz., from New Caledonia. The first brief description was given by Harvey in October 1859, and then Kützing, without knowing of this publication, described the other species as *Polyphysa spicata*, Kütz., which Sonder subsequently, again without knowing of the Harveyan genus, distinguished by the name of *Pleiophysa spicata* without farther statement. Since then Agardh only has made farther examination of these rare plants; Cramer had no material *.

* See note on p. 39.

Notwithstanding its aberrant external appearance, *Halicoryne* approaches in its structure near to *Acetabularia*, sect. *Polyphysa*, as Kützing justly recognized and expressed in the name he gave it. Its erect stem is clothed in regular sequence with whorls closely occurring, alternating, and with different characters; and, according to the kind of whorl, more or less strongly developed at the nodes. It terminates in a cupola or dome-shaped growing-point, surrounded by the young bud-like whorls, which are inclined towards it; or, when its growth in length has ceased, quite abruptly, with a flat surface immediately above the last fertile whorl. The whorls consist in one case of repeatedly multisect hair-tufts of the usual kind, developed as a rule in groups of eight, but very soon falling off and leaving only their round scars on the surface of the stem. These whorls correspond to the less pronounced swellings on the axis. Between these, and, as has been indicated, present only on the full-grown plant, there are 16-branched whorls of a different kind, arising from the more prominent swellings of the stem. Its branches are completely free, and consist of an almost cylindrical basal portion seated on a small vestibular fold of the stem-tube and divided from it by a basal partition-wall in the well-known fashion, and of a terminal, simple, longish ovate, pointed vesicle curved somewhat upwards and almost pod-shaped—the sporangial ray of the adult fertile plant. On the upper side of the basal portion, in the neighbourhood of the place where it turns into the sporangial ray, there is a minute papilla-like convexity which bears a terminal, short, unicellular hair-process, or two of them, one behind the other. In young branches these hairs are firm and erect, and in the mature ones collapsed; they remain, however, at least in *H. spicata*, always persistent, while in the other cases they often, certainly not always, disappear.

In *Halicoryne Wrightii* this convexity is always recognizable, even in the mature state, as a small but still definite process; in *H. spicata* its elevation is so slight that it barely appears on the mature branches, and the hair-cells rise simply from the surface of the basal portion (comp. Plate IV. figs. 9, 11). We have in it the very feebly developed parts of the corona superior (comp. Plate IV. figs. 4, 5, 10).

While in *Acetabularia* the cap-whorl reaches full development first on the older and already strengthened plants, the youngest specimens in this case that I have seen are provided with both sorts of whorls in complete and regular alternation. In such plants, however, there is no spore-formation, which occurs only on the older individuals of about a finger-length. In the young plants of *H. spicata*, so far as I can perceive, the branches of the sterile fructification-whorl are pointed upwards and lie like roof-tiles over each other, much as Kützing has figured them; in those of *H. Wrightii* (collected by the 'Challenger' Expedition at the Philippines) they sprout forth at right angles from the stem-cell and become recurved and hang down parallel with the stem. So long as the branches of the fertile whorl do not form spores and remain sterile, the basal portion stands in wide open communication with the sporangial ray; when the spores are formed a partition is developed which is characterized by strong and often very irregular thickening (Plate IV. figs. 4, 10, 11). Agardh has given a description, correct in the main points, of the structure of *Halicoryne*; he has recognized the alternation of the different whorls and has seen the coronal prominences on the basal portion of the cap in *H. Wrightii*, which he only has investigated, although the proportions are not rendered on his plate v.

exactly true to nature. The hair-scars also have escaped his notice. The very characteristic lime-incrustation of *Halicoryne* does not appear to have been taken into account by Agardh, who at all events does not describe it.

If we examine the surface of the axial tube of the young part of a plant, the whole external surface of the membrane will be seen to be covered with round scale-like groups of minute needle-shaped crystals of calcium carbonate, between which there remain small interstices almost free from lime. These scales subsequently increase greatly in size, and are easily broken out with a needle; they become united into a continuous crust, though the interstices are much less strongly calcified. If the carbonate be dissolved with acetic acid, the thick membrane is left clear as glass, and there are to be seen numerous oxalate crystals, often densely occurring, firmly attached to its inner surface. Transverse sections show that the thick, strongly refractive, clearly stratified membrane remains wholly free from lime, and that the incrustation is only in a slimy coating developed on the outermost margin; its unequal distribution may have given rise to the scaly lime-formation. On decalcifying such sections one sees the slimy substratum of the incrustation always appear in little hillocks at the places corresponding to the scales.

The whorl rays are the same in this respect, but in them the calcification is much less and inconsiderable.

The spores of *Halicoryne* (Plate IV. figs. 3, 7) are in structure similar to those of *Chalmasia*; they are, however, in the two species so far different that while in *Halicoryne Wrightii* they fill the sporangium with white globules in great numbers, in *H. spicata* they are present in much fewer numbers and are united in an irregularly formed aggregation like a small roundish oval stone, in which only after decalcification are the single elements, polygonal from mutual pressure, to be clearly recognized.

The single spore of *H. Wrightii* is almost globular, and is distinguished, as already mentioned, by the complicated structure of its extremely thick cell-membrane; to what has been said (under *Chalmasia*) with reference to the lid and its insertion there is nothing to be added. If the spores be embedded in gum and the sections so obtained be examined, the whole membrane will be seen to consist of three different layers. The greatest of these is the middle one, which is the seat of calcification. It exhibits a peculiar striation in the direction of the radii, which causes the delicate stratification, which is also present, to be scarcely apparent, if at all, though it is somewhat more distinct in *H. spicata*. The striation depends apparently on differences of density in the substance; the minute lime-granules of the incrustation, disposed in radial rows, follow it, and without doubt they are situated in the less dense layers, and they appear clearly during the first effects of dilute acetic acid or after treatment with chloriodide of zinc. After their solution the striation is still clearly apparent, but later it becomes less distinct from the swelling up. At the outer and inner margins of this layer of the membrane there is a denser seam showing the radial striation, but either free from or almost destitute of lime, which appears very sharply defined at the commencement of staining with chloriodide of zinc, because the colour-reaction begins in it later than in the remaining weaker part of the middle layer. The cellulose reaction is easily obtained, as de Bary has stated for *Acetabularia mediterranea*, and mere treatment with iodine is

sufficient to demonstrate it. The thick middle layer is bounded on the inside by a relatively thin, stratified, strongly refractive layer, turned blue with chloriodide of zinc; it directly encloses the contents. Outside the layer bearing the incrustation is the thin cuticle-like membrane, either not stained with preparations of iodine or merely turned yellow; at the commencement of swelling it readily rises up in folds and is then easily observable.

If the section passes through the lid of the spore (Plate IV. fig.8), several complications will be found at its margin. The marginal surface between lid and spore-membrane appears on both sides as a sharp line running through the membrane. This line consists of an extremely delicate, perpendicular lamella passing outwards into the cuticuloid layer and inwards into the internal layer. That these connections exist and that the lamella goes transversely through the incrusted layer is shown particularly clearly at the commencement of the swelling of the section, where, for example, the cuticuloid layer rises in folds and one sees the lamella in question emerge distinctly above the incrusted layer and pass into the cuticuloid one. It undergoes in this apparently a stretching, not shared in by the incrusted layer in the mass. We have seen that the incrusted layer possesses a denser margin on its inner and outer sides; a similar one is also presented towards the transverse lamella forming the lid-margin, so that it is accompanied on both sides by a more strongly refractive seam of the incrusted layer connecting the similar portions of the outside and inside, in the lid as well as the rest of the spore-membrane.

When sections passing through the lid have been carefully treated with acetic acid and then stained with a little iodine, the subsequent treatment with concentrated sulphuric acid causes the membrane, coloured blue, to swell up enormously. The outer cuticle-like lamella and the lamella separating spore and lid do not take part in the staining. The inner layer swells up and exhibits its stratification; soon this stratification becomes indistinct, and all begins to dissolve, with the exception of the outer cuticuloid layer and the lamella between spore and lid. Finally this latter is destroyed, and there remains only its point of connection with the outer layer as a knob-like swelling forming a circle in a surface view of the section. In the end there is left over only the cuticuloid layer, which undergoes no farther alteration. This layer, however, is not a true cuticle, since, apart from its resistance to sulphuric acid, it shows none of the characteristic reactions of cuticle, is unaltered in chromic acid, and does not turn yellow on warming in potash. Of what nature this modification is must be left undecided.

In the examination of spores, decalcified most carefully with very dilute acetic acid, there always appear outside the cuticuloid layer several very delicate parallel marginal lines which appear to indicate the presence of a clear, stratified, gelatinous envelope. If it be really present one would regard it as the equivalent of the slime mass which envelops the spores of *Acicularia* and binds them together, serving as the substratum of calcification *. Since, however, in examining sections of embedded spores, I have never been able to discern again the least trace of this, I am doubtful whether these lines may not be ascribed to an optical illusion. I should have liked to examine the condition of the spore-membrane on the opening of the lid, but I had no suitable material. It is

* The adhesion of the spores of *Halicoryne spicata* might be similarly explained.

manifest that in this process the cuticuloid lamella as well as the inner layer must be separated by a circular cut. The transverse lamella, bordering the margin of the lid, less altered than the cuticuloid layer, must then serve as a sliding surface at the removal of the lid, but whether it remains with the lid or with the spore I must leave undecided.

Disregarding the great structural differences that exist between the series of *Cymopolieæ*, *Bornetelleæ*, and *Acetabularieæ*, the systematic connection of these groups has so impressed recent authors that they either unite them all as *Dasycladeæ*, or they divide them into two allied families of *Dasycladeæ*, which in this case also includes the *Bornetelleæ* and separates off the *Acetabularieæ*. The more our knowledge of all these genera increases the more clearly manifest becomes their connection—their morphological homology. In spite of this, the literature contains only a few attempts at a careful comparative treatment of their organs. Only in Falkenberg, in Wille, and in Cramer do I find observations of the kind. They carry out quite correctly the comparison of the main axis—the stem, as well as the verticillate lateral members borne by it—the leaves, which are distinguished by limited duration of growth and become the bearers of the fructification. These leaves are either all alike or they are of two sorts, partly sterile and hair-like, frequently di-polychotomously branched, and partly fertile and club-shaped. Falkenberg goes farther than Wille, since he says (p. 270) of *Acetabularia* :—"The cell-branches which unite to form the cap are distinguished from the other verticillate branches not only by the absence of further branching and by their persistence on the axis, but by the fact that in them only does the formation of reproductive cells take place, while the hair-branches, like the chambers of the rudimentary cap, remain sterile." This rudimentary cap is our corona inferior. That follows from the passage which says :—"So the cap is doubtless to be regarded as equivalent to the previously formed hair-whorl of the shoot of *Acetabularia* ; the transition from this hair-whorl to the mature cap-whorl is facilitated by a branch-whorl which remains rudimentary and surrounds the cap as a cushion on its under side . . . . Ordinarily the capacity for forming caps is extinguished with the development of the first fully-formed one. Above it, however, there are formed several whorls of umbellate hair-branches, which soon fall off ; but the internodes of the main axis do not extend above the cap, and the membrane of the main axis, in which they were inserted, showing the scars of the fallen branches, surrounds the navel-shaped depressed apex of the shoot in the form of a circular wall." According to this view the cap is a highly complicated aggregation of hair-whorls placed together, of which one goes to the corona inferior, another to the sporangial rays, and several to the corona superior. Falkenberg has examined only *Acetabularia mediterranea*, and it in a mature state; otherwise he must have convinced himself of the untenability of his opinion. The position of the hair-scars in all *Polyphysæ*, particularly in *Acetabularia polyphysoides* and *A. Möbii*, where they form a whorl on each side of the coronal prominences (Plate IV. figs. 2, 6), shows that we have to deal in it simply with the parts of a complete peculiar body—the coronal prominences. To this is to be added the late appearance of the sporangial rays in the development of the cap of *A. mediterranea*, in which an originally undifferentiated primordium breaks up into corona superior and an under portion which,

long after the commencement of the growing out of their hairs, divides itself into sporangial ray and corona inferior. It is impossible to close one's eyes to the view that the whole chamber with all its parts represents a complete formation, if, indeed, one may not take it as the homologue of a single whorl. That this may be so I believe I am in a position to prove. It is common to all *Dasycladeæ* that the branching of their short shoots is of the di-polychotomous type, and to this rule the *Acetabularieæ*, as regards their sterile branches, form in no way an exception. As regards the morphological position of the sporangia, there are two actually different cases, if we look away from *Acetabularia* and its allies. The one occurs among the *Cymopolieæ*, the other among the *Bornetelleæ*. In the former case the sporangium arises from the apex of the ray which has already produced its branch-whorl, if such there be; and this teaches us that we have to do with a cymose and not with a dichotomous or polychotomous system in the branching of the short shoot. In *Dasycladus*, *Neomeris*, and *Cymopolia* it is the primary shoot which terminates in a sporangium; in *Botryophora* secondary branches take part also in this transformation, but these have no farther branching. There thus arise lateral as well as terminal sporangia, but these belong to the branch-whorl itself and are homologous with the secondary rays. It is quite otherwise in *Bornetella*. Here the sporangia occur as lateral outgrowths in indefinite numbers and position from the primary ray, which ends blind in all cases after it has given rise to the characteristic whorl of secondary rays forming the rind. The sporangia of *Bornetella* are lateral new formations, and they should not be compared with the parts of the normal branching system.

How, then, do the sporangial rays of *Acetabularia* compare with this? I do not hesitate to assert that they could be compared only with those of *Bornetella*. In *Acetabularia polyphysoides*, for example, or *A. Möbii*, the basal part, together with the coronal prominences it bears, is equivalent to the basal part of the short shoot; the crown of hairs on the terminal prominences is the whorl of the secondary branches. It is plain that the sporangial ray does not belong to this whorl—it is a protuberance of the basal portion that is only apparently pressed into a terminal position. It is distinguished from the sporangium of *Bornetella* by its aberrant form, by its occurrence singly, and by its definite position on the basiscopic side of the branch. But these relations are not so clear in all *Acetabularieæ* as they are here. In the section *Polyphysa*, which affords simpler relations of organization, and in *Halicoryne* and *Chalmasia* as well, there is present a manifest limit between sporangium and basal portion; in *Acicularia*, *Acetabuloides*, and *Acetabulum* these become somewhat obliterated. And at the same time the wreath-like position of the secondary branches on the single sections of the corona becomes less clear, until finally, in many species of *Acetabuloides* and *Acetabulum*, they come together in a radius forming a single row. The most aberrant type is *Acetabularia mediterranea*, for long the only one closely studied, in which the closed connection of the parts is found.

With this statement the course of development is in accord. The apex of the ray, the corona with its hairs, is formed much earlier than the sporangium and may be regarded at first—at least with as much justification as the other—as the terminal portion of the

whole shoot (compare the figures, Plate I. figs. 4, 8, 12, of *Acetabularia mediterranea*, as well as Plate IV. fig. 5, *Halicoryne Wrightii*). The thrusting towards the acroscopic side happens through its excessive growth in size.

A beautiful confirmation of what has just been said came into my hands after the text of this paper had been prepared. A young specimen of *A. Peniculus* was examined, in which immediately beneath the cap, normal in all respects, there was a whorl of hairs which attracted my attention from the vesicular form of its branches. Closer examination resulted in disclosing a very remarkable anomaly (Plate II. fig. 2). Among the short shoots of the whorl in question there were single ones of quite normal character, polychotomous, provided with cylindrical, hair-like, long cells of the same order as the branches. Most of them, however, were transformed into arrested fruit-discs. The stalk was formed of the primary branch of the short shoot; its secondary branches were shortened and bore at the apex in place of the tertiary outgrowths, as a rule, one terminal, short, papilla-like cell, rarely two inserted together. That these represent the branches of the third degree there could be no doubt. The sporangial ray appeared as a more or less developed knob, sometimes constricted at the base and vesicular above, on the basiscopic side of each of the secondary branches of the short shoot; it never attained complete development, and always persisted in a distinctly lateral position. We have to do here, then, with the formation of caps of a higher order, since the secondary branches of the short shoot undergo the same alteration as occurs otherwise only on the primary ones. By a farther development of the anomaly we should have a plant of which the terminal fruit-disc would be surrounded by a complete whorl of similar lateral ones. Perhaps Woronin's observation of a branching *Acetabularia mediterranea* in which each branch bore a cap may be explained in this way; or, on the other hand, it may be only a fasciation-like forking of the stalk of the apex.

Among the *Cymopolieæ* we meet with a farther difference of organization, in which the two other groups do not share, in the absence or presence of spore-formation in the sporangia. We have to thank Cramer for a criticism of the systematic significance of this character. He makes out that we are compelled, in the employment of this character for the classification of the Order, to separate the neighbouring genera *Botryophora* and *Dasycladus*, *Neomeris* and *Cymopolia*. That these two groups of genera, of which one is incrusted and the other is not, have been farther differentiated in analogous fashion is scarcely doubtful. But which of the divisions of each of these two groups is the original one, which the more strongly modified and the more advanced? I am of opinion that one may not doubt, with reference to the alternation of generations of sexual and asexual individuals so general among the *Chlorophyceæ*, that those forms in which it fails, in spite of the apparent simplification of the course of development, are still the most modified phylogenetically. So in this case *Dasycladus*, in which the sporangia, intermitting the spores, directly produce gametes, the product of the conjugation of which I saw grow directly into a normal young plant; *Cymopolia*, where possibly sexuality has been lost, and only vegetative germination of the whole sporangia retained—provided that in the case of the preceding observations (Solms) we have met with no abnormality. *Dasycladus* would stand in some such way to *Botryophora* as *Cymopolia* to *Neomeris*.

It results from the comparison of these courses of development—as also from the similar cases of *Botrydium* and *Vaucheria*—with those of most *Chlorophyceæ*, that it is, particularly in the former group, the sexual generations that become rudimentary or eventually disappear, while otherwise this is the case with the asexual. In consequence we find in our group that the vegetative functions become attached to the asexual generation, while usually they are attached to the sexual.

Possibly the consideration of this phenomenon might throw some light on the peculiar apparently analogous separation of groups among the *Archegoniatæ,* where the Ferns, in their course of development, would correspond with the present group and the *Bryineæ* with the remaining *Chlorophyceæ*.

So much for the mutual relations of the genera of *Cymopolieæ*. The *Bornetelleæ*, including only the genus *Bornetella,* do not enter farther into the question, and we may finally turn to the consideration of the relations which exist among the genera of *Acetabularieæ*. There are two points of view in the disposition of the forms: first, the external development of the fertile plant; and second, the distribution of the incrusted parts in these. According to the first, *Halicoryne*, with its regular alternation of numerous vegetative and fertile whorls, must be placed apart from all other genera; according to the second we should have, from the occurrence or absence of incrustation in the interior of the sporangia, at least two if not three groups. One of these contains merely the genus *Acetabularia*, the other all the remaining genera; or if not, possibly *Acicularia* should be separated from the others as a group in which not the spore-membrane as in other cases, but rather a slimy mass within it of uncertain origin is the basis of the calcification. There is naturally no certain proof whether one grouping or the other is the correct one. But I should, after considering all the circumstances, place the mode of calcification in the foreground, especially on this account,—that *Halicoryne* in this respect agrees so absolutely with *Chalmasia*. We should then retain the two or three groups mentioned, and the peculiar cap-formation must be taken as occurring in the course of development at different times in the *Acetabularideæ* and *Halicorynideæ*. That the type of *Halicoryne* stands nearer the ancestral form of the whole family of *Acetabularieæ* than the cap-forming type of the other genera seems to be supported by its similarity to the more remotely allied types of the *Dasycladeæ*, from which it is distinguished by the alternation of fertile and sterile whorls, and besides by the lateral sporangium; and this alternation we have seen occur in *Acetabularia*, where this genus in its normal course of development, and not as a monstrosity, produces several discs in succession above each other. This case, only known as yet in *A. crenulata*, would seem to correspond to a reversion to a *Halicoryne*-like type.

Clavis Generum.

I. Sporæ incrustatione calcarea omnino destitutæ. Rami fertiles discum umbelliformem constituentes .... 1. ACETABULARIA.

II. Sporæ incrustatione calcarea præditæ.

A. Ramorum fertilium verticilli plures superpositi. Rami liberi vesiculiformes... 2. HALICORYNE.

B. Rami fertiles discum umbelliformem constituentes.

α. Sporæ incrustatione calcarea in spiculam aciculiformem coadunatæ, stratis membranæ interioribus calce destitutis .. .. 4. ACICULARIA.

β. Sporæ liberæ per totam membranam incrustatæ .... 3. CHALMASIA.

I. ACETABULARIA, Lam. in Bull. Soc. Phil. 1812, p. 185.

The erect axis, clothed with successive deciduous hair-whorls, terminating when ripe in a cap-like whorl, of which the rays are either free or joined together; each such ray equivalent to a cell of the hair-whorl terminating in a knob- or cushion-shaped process, closing its portion of the corona superior and bearing here branched hairs in various positions; coronal prominences forced into a lateral position by the development of the originally lateral sporangium, which finally contains the round or ovate spores with membranes free from lime, and opening after a time by means of a lid and emitting the gametes. These develop after germination into a plant which fruits once and dies down annually to the surface of the substratum, accumulating reserve-material in a basal portion which is immersed in the substratum and cut off by a partition-wall, and finally fruiting after its repeated diaphysis.

Clavis Specierum.

A. Disci fertilis radii ad apicem usque connati, corona superiore et inferiore præditi. Coronæ processus connati, superioris pilis uniseriatis 5 et ultra præditi. (*Acetabulum.*) .... 1. *A. mediterranea.*

B. Disci fertilis radii plus minus connati vel subliberi, corona superiore et inferiore præditi. Coronæ processus inter se liberi. (*Acetabuloides.*)

1. Radiorum septa lateralia verticaliter striata.

  α. Radii apiculati, processus coronæ superioris extus bilobati .... 2. *A. Kilneri.*

  β. Radii mutici, processus coronæ superioris integri vel leviter emarginati.

    a. Discus diametro 15–20 mm., membrana modice incrassata .... 3. *A. major.*

    b. Discus maximus 35 mm., membrana tenaci coriacea .... 4. *A. Gigas.*

2. Radiorum septa lævia, haud verticaliter striata.

  α. Radii apiculati.

    a. Coronæ superioris processus pilis ternis uniseriatis præditi. Discus parvus infundibuliformis, margine apiculis pyramidatis graciliter dentatus .... 5. *A. dentata.*

    b. Coronæ superioris processus pilis binis uniseriatis præditi. Discus major margine apiculis brevibus crenulatus.

      * Disci infundibuliformes sæpius plures superpositi, radiis apiculo convexo .... 6. *A. crenulata.*

      ** Discus planus, radiis apice emarginatis, apiculum parvum gerentibus. 7. *A. caraibica.*

  β. Radii mutici, omnino exapiculati, plus minus emarginati.

    a. Coronæ superioris processus pilis quaternis irregulariter uniradiatis præditi .... 8. *A. Suhrii.*

    b. Coronæ superioris processus pilis binis instructi. Radii omnino liberi.

      * Processus coronæ longe discreti, subtriangulares .... 9. *A. Calyculus.*

      ** Processus coronæ approximati, extus subemarginati .... 10. *A. Farlowii.*

C. Disci fertilis radii liberi, interdum incrustatione plus minus coaliti. Corona inferior nulla. Coronæ superioris processus inter se liberi. (*Polyphysa.*)

1. Radii omnino liberi, incrustatione nulla vel subnulla, æquali.

a. Radii vesiculiformes, obtusi. Processus coronæ pilis binis oblique seriatis instructi .... 11. *A. Peniculus.*

β. Radii sursum curvati, elongati, apiculati. Processus coronæ pilis ternis triangulariter dispositis instructi .... 12. *A. exigua.*

2. Radii incrustatione partiali laterali coaliti.

a. Processus coronæ pilis ternis instructi .... 13. *A. parvula.*

β. Processus coronæ pilis pluribus instructi.

* Pili circulariter dispositi .... 15. *A. Möbii.*

** Pili elliptice dispositi .... 14. *A. polyphysoides.*

Section I. Acetabulum.

Fertile disc composed of rays firmly united up to their tips, and having corona superior and inferior likewise laterally united, with ovate spores.

1. Acetabularia mediterranea, Lam. Hist. Polyp. corall. flex. 1816, p. 249.

Disc in fully developed state extended flat, when younger more or less concave; sporangial rays as it were cut off straight at the tips, with much thickened, completely united membranes; corona superior forming a circular continuous undulating ring surrounding the apex of the disc and corresponding without and within to the narrow individual coronal rays. Hairs or hair-scars on the apical surface of the coronal rays in a single row in greater numbers (5–7), generally in tufts; corona inferior of similar form, its rays in the apical view being notch-like at their outer margin.

Size of normal specimens: diam. of disc 10–12 mm., often much smaller: breadth of corona superior circa 0·125–0·150 mm.; longit. diam. of spores, circa 0·095 mm., transv. diam. 0·07 mm. (Plate I. figs. 4, 5, 7, 8, 12.)

This species, which is among the largest of the genus, is easily recognized by the characters of the section *Acetabulum.* Its mode of calcification has been closely studied by Leitgeb. Its degree varies very greatly; the calcification of the peripheral layers, which is excessive in sunny localities, may be completely wanting at greater depths or in shadow. The specimens then appear quite green.

Section II. Acetabuloides.

Sporangial rays more or less firmly united or completely or partly free; corona superior and inferior present, both consisting of free processes not united laterally with each other.

A. Side-walls of the sporangial rays notched together by distinct thick processes reaching from the upper surface to about the middle, gradually running out and springing towards the middle lamella. The largest species of the genus.

a. Sporangial rays with apiculum and with the process of the corona superior bilobed outwards.

2. Acetabularia Kilneri, Ag. Till Alg. Syst. viii. 1886, p. 171.

Fertile disc large, long-stalked, only terminal, extended flat or slightly infundibuliform upwards, moderately calcified. Sporangial rays (57 in number) firmly united

when fresh, but after decalcification easily separable from each other as far as the base of the corona, with the interlocking ribs irregular, but usually together in pairs and increasing in numbers towards the centre, and with flat but apiculate margin. Segments of the corona superior and inferior similar, narrow, very closely pressed together, deeply bilobed externally, often irregular from the unequal size of the processes, the membrane of which is much thickened. Hair-scars on the parts of the corona superior as a rule in fours, forming a series here and there pushed outwards. Vestibular folds much thickened in the surface view towards the apical membrane, standing out as strong, refractive, round knobs alternating with the rays.

Size: diameter of cap 10–16 mm.; breadth of corona superior 0·26 mm. (Plate I. fig. 6.)

It is found on the warmer Australian coasts—Edgecumbe Bay, coll. Kilner, Hb. Ag., Thuret, Strassburg; Port Bowen, Austr. or., coll. A. Dietrich, Hb. Thuret (nomine *A. crenulata*, var. *tricuspidata*, Grun.; a cel. Grunow missa).

Among the existing descriptions of different *Acetabulariæ*, which confine themselves for the most part to the citation of trivial things and are not therefore intelligible without an inspection of the original specimens, Agardh's representation of his *A. Kilneri* is a notable exception. He has not only rightly recognized the character of the section Acetabuloides, but also the form of the two coronas, and has seen the notch-processes of the side-walls of the sporangial rays, thus pointing out the actual differential characters of his species.

b. Sporangial rays without apiculum. Segments of the corona not deeply bilobed towards the outside.

3. Acetabularia major, Martens, in Preussisch. Exped. nach Ostasien, Bot. Theil, Die Tange, von G. v. Martens, Berlin, 1866.—*A. crenulata*, var. *major*, Sonder, Algen d. trop. Australiens, 1871.—*A. denudata*, Zanard. Phyceæ Papuanæ, N. Giorn. bot. Ital. 1878, p. 38.

In habit generally resembling *A. Kilneri*; cap large, long-stalked, extended flat, only slightly calcified. Sporangial rays (70–80 in number) united in the calcified condition, but separate from each other up to the base of the corona after decalcification; notch-processes of the side-walls much less sharply defined; apices of the rays blunt, cut off straight or somewhat emarginate, wholly without apiculum; segments of the corona superior and inferior of similar shape, those of the upper quite narrow, without emargination, each with a single series of about 8 hair-scars, those of the lower with a slight bulging outwards of the margin; spores seen only in an unripe state, and, considering their extraordinary differences in size, a scarcely normal condition.

Size: diam. of cap 15–20 mm.; breadth of corona superior 0·18–0·22 mm.; size of spores 0·075 mm.

Hab. On the tropical shores of Eastern Asia. Collected at Sima-haradscha, in Siam, in February 1862 by Schottmüller (Hb. Berol.); Atapapua, Timor (Hb. Strasb.); at Warbusi, in Geelvink Bay, New Guinea, collected by Beccari, March 1872 (coll. Becc. Strasb.).

4. Acetabularia Gigas, n. sp. *A. majori* simillima sed major, membranis coriaceis instructa, pilis in coronæ superioris processibus octonis vel decenis subuniseriatis.

Resembling *A. major* in all its characters, but much larger and more robust—the veritable giant form of the genus. Stalk not completely present up to 25 cm. and more in length; cap of 1·5 cm. radius; distinguished from *A. major* by the firmness and thickness of its membranes, by the much coarser and more definite notch-marks of the side-walls, in which it greatly exceeds *A. Kilneri*; rays, of which at least 76 were present, after decalcification easily separable up to the base of the corona; corona superior consisting of narrow segments entirely without emargination and bearing numerous (8–10) hair-scars, in one regular series on the inner and in two irregular series on the outer side, the outermost having only short hair-processes; segments of the corona inferior from the apical view longish ovate, quite without emargination; spores very numerous in each ray, relatively small and globular.

Size: breadth of corona superior 0·41 mm.; spores 0·077 mm.

Hab. In the seas of Eastern Asia.

The specimen preserved in the British Museum from Herb. Hance was collected floating in the sea, by Swinhoe, on the south-west coast of the island of Formosa, at Liang-kiau. As G. Murray writes to me, there are specimens of the same species named *Androsaces Luzonis*, and collected by Kamel in Luzon, in Herb. Sloane sub 163, fol. 2, and 223, fol. 36. The photographs of this plant, nat. size, kindly taken by Mr. Gepp, show a diameter of cap 25–27 mm., and come between *A. major* and *A. Gigas* in size. As to its other characters I cannot judge merely from the photograph.

It is not possible to combine this species with *A. major*, in spite of the very minute differences by which it is distinguished. Possibly, after a better examination of the localities, farther similar forms may be found. It will then be possible to settle the limits of the species, but meanwhile it appears to me at all events more expedient to maintain apart such extraordinary forms in spite of the slightness of their distinguishing characters.

c. Side-walls of the sporangial rays without distinct notch-ribs.

α. Sporangial rays with apiculate margin. Apiculum in *A. caraibica* absent altogether, or often stunted on certain rays, but seldom on all.

5. Acetabularia dentata, n. sp. Gracilis, disco infundibuliformi, tandem subexplanato. Disci radii pyramidato-acuminati, acuti. Processus coronæ superioris pilis ternis uniradiatis instructi.

Cap-forming plant, small and delicate, with short stalk up to 2 cm. in height; disc terminal, small (about 2 mm. radius), at first basin-, later dish-shaped, a flat margin appearing sharply toothed, often ultimately turned down. Sporangial rays 30–40, somewhat strongly calcified all round, united, but after decalcification for the most part separate, with very delicate, easily ruptured membranes, elevated pyramid-fashion at the apex, with concave border and sharp pointed apiculum. Segments of the corona superior small, somewhat crowded, longish ovate, externally very little or scarcely emarginate, with three hair-prominences in one row; corona inferior similar, but with sharp bilobed margin.

Size: diam. of cap 4 mm.; breadth of upper corona 0·11 mm. (Plate I. fig. 11.)

A. Calyculus, Zanard., non Quoy et Gaim.

Hab. In tropical Eastern Asia: first collected in a young unripe state at Sorong, New Guinea, and determined by Zanardini as *A. Calyculus*, Quoy et Gaim., afterwards at Macassar in Celebes (no. 927) together with *A. parvula*, also at Maumeri in Flores (no. 1198) by Mrs. Weber van Bosse. Probably the specimens distributed as *A. caraibica* by Vieillard (no. 2047), from New Caledonia, belong to this species, but the plants are too young for determination.

The specimens from Maumeri preserved in alcohol permitted closer study of the dense and repeatedly polychotomous hairs, of which one for each coronal segment attains development. Ordinarily this is the outermost, sometimes the second of the prominences, in which latter case the outermost develops into a somewhat thick-walled knob. The New Caledonian plant shows three, in many cases four hair-scars, with the hair-tuft as a rule arising from the innermost.

A. dentata is easily to be distinguished from the two following species by its small size, the peculiar dentition of the margin of the disc, the inequality of the two coronas, and the hair-scars being in threes.

6. ACETABULARIA CRENULATA, Lam. Hist. Polyp. corall. flex. 1816, p. 249.

Plant large. Discs of the younger individuals generally 2–4, above each other, and between them in each case the scars of hair-tufts; on older plants mostly only the terminal ones persist, and beneath them the nodular thickenings of the stalk denoting the places of attachment of the others.

Discs basin-shaped, rarely flat, strongly calcified, formed of numerous narrow, united rays (32, 57, 60, 80 counted), with cupola-like arched ends with short apiculum. Corona superior and inferior alike formed of longish crowded segments, externally more or less clearly emarginate and with very much thickened membranes. Hair-prominences of the corona superior in pairs, one behind the other, on each segment.

Size: diam. of cap in good specimens 10-15 mm.; breadth of corona superior 0·22–0·26 mm.; diam. of spores 0·075 (according to Cramer 66–83 μ). (Plate I. figs. 1, 2, 3.) Exsicc. Farlow, Anderson & Eaton, Alg. exsicc. Amer. bor. no. 42.

Hab. At the southern point of Florida (Key West); in multis colls.—Guadeloupe (S. Martin, Lac de Simpson, Conquérant no. 44 Hb. Thuret); Bahama Islands, Herb. Berol.; Cobija, Bolivia, coll. Osthaus (Hb. Göttingen), on wood, in company with *Neomeris annulata*. ("Dans les eaux tranquilles, peu profondes, souvent troublées et fortement échauffées par le soleil, sur des rochers ensablés, des bois immergés, le plus souvent même dans le sable. Se rencontre assez fréquemment en parasite sur l'*Halimeda* et le *Dasycladus*. N'a pas de saison, persiste toute l'année, entre en végétation en Décembre." —*Mazé et Schramm.*)

I was able to study the disposition of the hairs on a specimen from Key West. The developed hair-tufts form a wreath, while those of the outermost scars are regularly stunted. In addition to this, far fewer tufts than rays reach full development, while every fourth coronal segment bears a fully-developed hair-tuft with three lying between having no such tufts.

Compare what has been said on this point under *A. dentata*. Should these differences prove constant on farther investigation, they would yield important differential characters, but this cannot be established on the scanty material of our collections.

Typical specimens of *A. crenulata* are very easily recognized even at the first glance. All the same, there are forms which connect with the following species so well that their determination becomes difficult. The precise limits of the species must be laid down after farther study on richer material.

7. ACETABULARIA CARAIBICA, Kütz. Tab. Phyc. vi. 1859, t. 93.

Disc mostly flat, slightly calcified, often almost without lime, terminal. Rays fairly numerous, 34–40, in the larger forms 50–60, firmly united; apex depressed in the middle, somewhat sunk, with a small apiculum, sometimes not distinct. Corona superior and inferior as in *A. crenulata*, the former with two hair-scars, one behind the other, on each segment.

Size: diam. of disc 6 mm.; breadth of corona superior 0·15 mm.; spore diam. 0·1 mm. (Plate I. fig. 10.)

Hab. Guadeloupe: coll. Duchassaing (Hb.Götting. Berl.); Mazé & Schramm, no. 1347 (Pointe-à-Pitre); Herb. Thuret, Berl. Strasb. This number is a form approaching *A. crenulata*; Moulé, "sur des pierres détachées au fond du port," 276, Hb. Thuret.

As already stated in the description of *A. crenulata*, this species is very nearly related to it, but is generally to be distinguished by the terminal, flat, and slightly calcified cap, and the unusual form of the points of the rays. Especially if it bear several caps above each other (*A. caraibica*, β *calyculata*, Kütz.) it is to be regarded with caution. As a matter of fact, one often finds in herbaria, under the latter name, typical specimens of *A. crenulata*. On the other hand, it may resemble the following form very much if the apiculum disappears; indeed Agardh has united them, as appears from his diagnosis; however, they are to be distinguished by the number and position of the coronal segments.

β. Sporangial rays blunt, more or less scolloped at the margin, apiculum absent.

I. Segments of the corona superior with about four hair-insertions; rays united by the calcification of the side-walls, but completely separate after treatment with acid.

8. ACETABULARIA SUHRII, n. sp. Gracilis, disco subinfundibuliformi. Disci radii obtusi vel emarginato-præmorsi. Processus coronæ superioris pilis quaternis uniradiatis obsessi. Syn. *A. caraibica*, Ag. ex parte.

Belongs to the smaller forms (total height 1½–3 cm.). Stalk stiff, strongly calcified, bearing a single, terminal, infundibuliform disc, slightly calcified, and that principally in the side-walls. Sporangial rays in moderate number (25–30), with blunt margin, as if bitten off and more or less deeply scolloped. Segments of the corona inferior of somewhat rectangular outline, externally slightly emarginate, those of the corona superior separated from each other by distinct interspaces, irregularly elongate, externally as a rule somewhat deeply scolloped, with 3–4 (mostly 4) hair-scars, of which the outermost may be thrust aside.

Size: diam. of cap 6–7 mm.; breadth of corona superior 0·09 mm. (Plate I. figs. 9, 13.)

Hab. Shores of St. Thomas (Antilles): Herb. Berol., ex herb. Mertens et Suhr. I have seen in the Vienna Museum a plant from Jamaica, Friedrichsthal, with only three oblique hair-scars.

This plant, nearly allied to *A. caraibica*, is clearly distinguished by the shape of the apices of the sporangial rays and by the greater number of scars on the coronal segments found on all the specimens I was able to examine. Though *A. crenulata* and *A. caraibica* exhibit in the decalcified state a separation of the individual rays up to the base, this is here more markedly the case. Suhr appears to have observed this, since he has actually determined one of his specimens as "*Polyphysa.*"

I have seen in the British Museum a plant from Ceylon very like *A. Suhrii*, at most differing only slightly in shape and in a greater arching out of the upper corona segments. It was collected by H. Trimen on shallow sandy places on 7th February, 1890, at Nakativanturai, near Jaffna, and noted by him as equal to 153 of the Ferguson collection. Owing to the scanty material, a more definite determination of its relationship is not possible.

II. Segments of the corona superior with two hair-insertions. Rays even in the living state separate and free.

9. Acetabularia Calyculus, Quoy et Gaimard, in Freycinet, Voy. 'Uranie' et 'Physicienne,' Zool. t. 90. figs. 6, 7.—Harv. Phyc. Austr. vol. i. pl. 21.

Of intermediate size, with a delicate terminal cap on a longish stalk; stalk with spindle-shaped swellings bearing hair-scars. Disc delicately basin-shaped in consequence of the curving upwards of all the rays, which are not very numerous (22–25). These are scarcely if at all calcified, and separate and free from each other to the lowest basal portion, bearing the coronal segments, and each springing from a small protuberance of the central area; sporangial rays closed towards the basal portion, compressed from the tip downwards, deeply emarginate, scolloped; segments of both coronæ free, remote from each other, blunt, those of the upper externally almost triangular, with two hair-insertions one behind the other, or sometimes three, when they are triangular in arrangement with the point directed inwards. Spores globular.

Size: diam. of cap about 4 mm.; breadth of corona superior 0·11 mm. (Plate III. figs. 6, 7, 8, 10.)

Hab. Australia: Baie des Chiens marins, West Austr. (*Quoy et Gaimard*); Owen's Anchorage, Fremantle, West Austr. (*Clifton* fide *Harvey*, Hb. Dubl.); Fremantle, Bowerbank coll. Br. Mus. (specimina in spiritu vini cons.); Deception Bay, Queensland, coll. Th. L. Bancroft (*Askenasy*).

The original specimens of this species appear to be no longer in the Paris Museum; I have not seen the Harveyan originals, but the specimens in the British Museum from the same locality, which I examined, corresponded so exactly to his description and figure that all doubt of their identity may be excluded. Harvey's plate renders the habit of the plant most strikingly. At the first sight of the spirit-specimens in the British Museum I took them to be *Polyphysa Cliftoni*, Harv., on account of the entirely free rays of the cap, and was accordingly much astonished when I recognized the corona inferior

and with it the character of *Acetabuloides*. I was then inclined to form from this species a peculiar group, *Polyphysoides*, but was soon able to convince myself that as regards the union of the rays all possible degrees were represented in the *Acetabuloides* series, so that *A. Calyculus* was merely an extreme case. The well-preserved specimens of *A. Calyculus* permitted me to ascertain the distribution of the hair-tufts on the corona superior. Each segment of the corona bears such a tuft almost regularly, and it arises from the inner insertion, while the outer produces only a blunt, unicellular, hair-like knob.

We may here consider a doubtful *Acetabularia*, very hard to elucidate owing to the dearth of material, which Harvey collected in the lagoon of Tongatabu (Friendly Islands) and distributed as no. 18 in his 'Friendly Island Algæ.' I saw it in the London collections and in Hb. Thuret. Although its rays are connected they show a certain independence, and in its habit the form approaches our plant. However, it is possible to believe that it is another member of the series of forms of *A. caraibica* so exceedingly difficult to define.

10. Acetabularia Farlowii, n. sp. Minor, brevipedunculata. Disci radii soluti, flexuosi, apice obtusi, emarginati. Coronæ superioris processus pilis binis uniradiatis præditi.

A very small and apparently short-stalked plant with white calcified stalk, and completely free rays of cap curved upwards, and in ripe specimens appearing entangled with each other; sporangial rays, about 30, slightly compressed towards the blunt emarginate points; corona inferior and superior more closely adpressed than in *A. Calyculus*; both with segments somewhat broadened externally and usually faintly emarginate, those of the corona superior with two scars, one behind the other; spores large and round.

Size: diam. of cap 6–7 mm.; breadth of corona superior 0·15 mm. (Plate III. fig. 1.)

Hab. Southern point of Florida, Key West (*Farlow* in Hb. Thuret).

Unfortunately I have seen only three broken-off specimens of this peculiar species, and they wanted the lower end of the stalk, that were sent by Farlow to Thuret. From the structure of the corona it is nearer *A. caraibica* than *A. Calyculus*, with which it has, however, in common the completely free rays. It is to be hoped that this remarkable plant will be found again soon.

Section III. Polyphysa.

Rays of the cap completely free, inserted on small projections of the central portion, at most united by lime-incrustations; corona inferior absent, superior composed of free knobs bearing hair-tufts.

A. Rays of the disc completely free, quite uncalcified, or with a very slight lime-incrustation, evenly disposed.

11. Acetabularia Peniculus.

Plant long-stalked, disc with few rays (8–12), single rays completely free, with narrow basal portion convex below and bearing the button-shaped coronal process above. Sporangial ray inserted on the basal portion with a constricted base and closed against it, vesicular, about twice as long as broad, not at all compressed, with blunt, rounded

apex, and very slight, evenly disposed calcification; hair-scars on the top of the coronal process mostly in pairs and obliquely placed, seldom in threes forming a triangle pointing inwards. Spores globular.

Size: diam. of cap 5–7 mm.; breadth of coronal process measured radially 0·11 mm. (Plate II. figs. 2, 6, 7.)

Fucus Peniculus, R. Br. in Turn. Hist. Fuc. iv. p. 77, t. 228.—*Polyphysa aspergillosa*, Lamour., Polypiers flexibles, p. 252, t. viii. f. 2; Expos. méth. p. 20, t. 69. figs. 2–6.

Hab. Australia: King George's Sound (*R. Brown*; *Harvey*, no. 565, in mult. coll.): Swan River? (*Drummond*, Hb. Kew); Port Phillip (*Harvey*, Hb. Berol. Strassb.).

Var. β. CLIFTONI. (*Polyphysa Cliftoni*, Harv. Phyc. Austr. vol. v. tab. cclv.)

Sporangial rays 10–16, not calcified at all, narrow, club-shaped, not vesicularly inflated, 3–4 times as long as broad. Hair-scars mostly three on the coronal processes.

Size: diam. of cap 10 mm.

Hab. Fremantle, West Australia (*Clifton*, Hb. Trin. Coll. Dubl., spec. orig.; Hb. Brit. Mus.).

I am convinced, from the examination of the original specimen kindly sent to me, that no sharp distinction can be drawn between this form and the usual *A. Peniculus*. Its characters are found here and there in specimens of the typical form, in patches of which single caps exhibit the habit of *Polyphysa Cliftoni*. Now the pairs and now the triple hair-scars prevail for each coronal segment; but precisely on the specimens collected by Clifton, which agree more than any others with the original of *P. Cliftoni* in appearance, I find usually only pairs of hair-insertions.

12. ACETABULARIA EXIGUA, n. sp. Minime brevipedunculata. Disci radii pauci soluti, elongato-ovati, obtusi, sursum curvati. Coronæ superioris processus rotundato-convexi, pilis ternis in triangulum dispositis prædit.

Small, 5–6 mm. high, short-stalked and immersed in the coral substratum; disc formed of few rays, 6–10, with basal portion constricted on both sides, bearing the knob-shaped roundish coronal segment with three hair-scars; sporangial rays seated on basal portion and communicating with it, cucumber-shaped, curved upwards with long drawn-out points.

Size: diam. of cap 2·25 mm.; breadth of coronal processes measured radially 0·046 mm. (Plate II. figs. 1, 4.)

Hab. Tropical Eastern Asia, Macassar, Celebes: a few sterile specimens sent me, sub 926, by Mrs. Weber van Bosse; Sikka, on the south coast of Flores, no. 1199 (*Mrs. Weber van Bosse*). The latter specimens, which were fertile, were obtained from a piece of coral on which *Neomeris dumetosa* was growing, after its decalcification.

I am unable to say anything more definite as to the calcification of the sporangial membranes of this species, than that the few sterile specimens from Macassar were uncalcified. The others came under my observation only after lengthened treatment with acid. However, their sporangial rays are so widely separated from each other that a union of these by means of lime-incrustation is scarcely likely. On this account the plant finds its right place here. It is distinguished with the greatest ease from

A. Peniculus by the quite aberrant form of its sporangial rays. I was able to study the disposition of the hair-tufts in a young sterile specimen, thanks to its having been preserved in spirits. On each coronal segment one of these is produced, which springs from one of the two outer insertions. The other two hair-processes are stunted and appear as simple unicellular knobs.

B. Rays of the disc united by strong calcification of the side-walls.

a. Coronal segments roundish knobs with three hair-insertions.

13. ACETABULARIA PARVULA, n. sp. Minima, brevipedunculata, disco plano rotato. Radii ad septa tantum incrustati, inde subcohærentes, vesiculiformes, clavati, obtusi, apiculo perpusillo instructi. Coronæ superioris processus subtriangulari-rotundati, pilis ternis ad angulos dispositis instructi.

Small, short-stalked, with a terminal, flat expanded, wheel-like disc; rays few in number (about 16), very little calcified on upper and under sides, but strongly on the side-walls and thereby connected; lime layers between the rays at the outer margin projecting in the form of emarginate buttons. Sporangial rays thick, vesicular, clavate, obtusely rounded, with minute apiculum, seated on a basal portion constricted on both sides, which bears the knob-shaped coronal process with the three roundish triangular hair-scars.

Size: diam. of cap 2·12 mm.; breadth of coronal process measured radially 0·042 mm. (Plate II. figs. 3, 5.)

Hab. Tropical India; collected at Macassar (Celebes) with *A. dentata* by Mrs. Weber van Bosse.

β. Upper surface of coronal segments radially elongated, and with an elliptical group of numerous hair-insertions.

14. ACETABULARIA POLYPHYSOIDES, Crouan, in Mazé et Schramm, Essai de Classification des Algues de la Guadeloupe, 2nd ed. p. 84. Minime brevipedunculata, disco rotato parce incrustato. Radii pauci, vesiculosi, obtuso-rotundati, subliberi. Coronæ superioris processus pilorum octonorum vel novenorum seriem verticem ellipticum circumdantem gerentes.

Diminutive plant, with short stalk and circular expanded disc, and the side-walls slightly calcified. Sporangial rays few in number (12–15), seated on the small constricted basal portion, vesicular and swollen, obtuse and rounded, with rudimentary or absent apiculum. Segments of the corona knob-shaped, radially elongated upwards, with oval, apical surface, on which there are 8–9 hair-insertions, forming an elliptical figure. Hair-tufts short and copiously branched.

Size: radius of the disc 1·75 mm.; breadth of the coronal knobs measured radially 0·15 mm. (Plate IV. figs. 2, 6.)

Hab. Guadeloupe, Pointe-à-Pitre. ("Ilôt à Cochons, sous la batterie O; mêlé à des *Centroceras* en tapis sur des roches ensablées qui ne restent à découvert qu'aux plus basses marées. Vert brillant à l'état de vie. En Février 1861 très rare."—*Mazé*, ser. i. no. 223.) Specimen in British Museum, Hb. Thuret.

From the numerous hair-insertions there arise mostly clavate hair-knobs; only the middle ones appear to bear fully developed hair-tufts, which are very dense, but are remarkable for their smallness and shortness.

γ. Coronal segments knob-shaped, with roundish upper surface and a circular group of numerous hair-scars.

15. Acetabularia Möbii, n. sp. Minima, brevipedunculata. Disci radii vesiculares, rotundato-obtusi, breves, septis tantum incrustatis. Coronæ superioris processus pilorum quinorum circiter seriem gerentes, verticem circularem circumdantem.

Diminutive, short-stalked plant, with rugose stalk showing several diaphyses; disc terminal, with about 15 rays, rarely two above each other, and in such case without any intervening hair-tufts; sporangial rays inflated, arising from a basal portion constricted on both sides, twice as long as broad, with obtuse rounded ends; outer walls of the rays not calcified, lateral walls united by strong calcification with nodular emergences at the margin; coronal knobs with roundish apex bearing a circle of about five hair-insertions; hair-tufts copiously branched, dense, but very short.

Size: length of disc-rays 1·37–1·62 mm.; breadth of coronal knobs radially measured 0·09 mm. (Plate IV. fig. 1.)

Hab. On coral reefs, Mauritius (*Möbius*; *Pike*, no. 168, Hb. Kew, Hb. Brit. Mus.).

This plant is nearly allied to the East Indian *A. parvula*, with which it completely agrees in the mode of calcification and in habit, but is distinguished by the numerous hair-scars of the coronal knobs forming a circular group. Möbius collected only one plant and preserved it in spirits. It bore two caps above each other, which I have not seen in the few specimens of Colonel Pike. It bore farther, on the hair-insertions, very thick-walled short hair-rudiments, while on Pike's specimens only the hair-scars were to be recognized, and these were very delicate. Whether there may be other differences, farther investigation on the spot must decide.

II. HALICORYNE, Harv.

Clavis analytica Specierum.

1. Rami sporangiales patentes vel deflexi; sporæ liberæ .... 1. *H. Wrightii.*
2. Rami sporangiales suberecti; sporæ in massam irregularem conglutinatæ......... 2. *H. spicata.*

The upright axis clothed with alternate differently formed whorls of branches, of which the one consists of few branches—8—longish, tufted, branched hairs, the other of mostly 16 branches, simple, longish ovate, pointed, almost pod-shaped vesicles, slightly curved inwards above and completely free and fructifying in the adult plant. These fertile branches, on the fructifying plant, inclined towards each other upwards and separated from the small vestibule only by a basal partition-wall, bearing on the upper side, not far from the base, a small protuberance which is furnished with one or two diminutive, rudimentary hairs, reduced to an oval cellule. In the fertile state the upper part of the vesicle is cut off by a thick partition-wall from the cylindrical basal portion immediately in front of this hair-decked protuberance. In this so separated sporangial

ray a small number of spores are formed, distinguished by their very strongly calcified membranes; spore-membrane stratified, with a definite lid; calcification of the axis only in the outer layers, forming irregular warty flakes consisting exclusively of carbonate of lime; the pod-shaped sporangial rays are also covered externally with a thin areolated incrustation of lime.

Whether repeated diaphysis occurs in this genus as in other calcified *Dasycladaceæ* I cannot definitely say, since I have been unable to obtain the very young plants on which alone this could be determined. As soon as the plant once fructifies, it appears then to have reached the end of its development. On a specimen of *H. spicata* examined with this view an active growing point was no longer present, and above the last fertile whorl, which, like the next, contained small spores, the axis ended in a flat surface with thickish walls. In the copiously branched basal portion there was no protoplasm to be found to indicate the probability of a new shoot.

1. Halicoryne Wrightii, Harv. in Proc. Amer. Acad. iv. p. 333 (1859). Verticilli steriles horizontales, demum deflexi. Radii fertiles sporas liberas continentes, membrana crasse incrustata instructas.

Sporangial rays of the young plant extended at right angles, ultimately drooping backwards along the axis. Sporangia and spores somewhat large, the latter globular, fairly numerous, with very strongly calcified membranes, completely free and in no way united or adhering.

Size: mature plant 3–4 cm. high; length of disc-ray with basal portion 2·2 mm.; of the basal portion 0·18 mm.; spore diam. 0·18–0·22 mm., of which the thickness of the membrane is 0·02–0·03 mm.; breadth of lid 0·11 mm. (Plate IV. figs. 4, 5, 8, 10.)

Hab. On the Loo-choo Islands, first collected in 1856 by the French naval officer Thomas (ins. Nawa), Hb. Thuret; in the same place by Wright on the muddy shore (Hb. U.S. North Pacific Explor. Exped. no. 13), and described from these specimens by Harvey, Hb. Thuret. At Mactan, Philippines, May 1876, by Moseley ('Challenger' Exped., Hb. Brit. Mus., Hb. Kew.).

All the specimens of Wright examined by me, and also those of the 'Challenger' Expedition, are young and sterile, and I was able to study the fruits only on those collected by Thomas. Agardh appears, however, to have obtained fertile specimens from Wright's material. His statements are on the whole correct; he found the small hair-protuberances on the sporangial rays as well as the traces of the alternating hair-whorls. The calcification of the spore-membrane has escaped his notice.

2. Halicoryne spicata, Kütz. Verticilli steriles sursum convergentes. Radiorum fertilium sporæ in massulam irregularem conglobatæ, membranis incrustatis instructæ.

Sterile sporangial rays of the young plant, erect, converging, the fully grown ones not much more than half the length of those of the preceding species; spores few in number and cohering in a mass not quite filling the ray, irregularly polygonal, with strongly calcified membranes.

Size: length of the disc-ray with basal portion 1·37 mm.; spore diam. 0·15 mm.; thickness of spore-membrane 0·022 mm. (Plate IV. figs. 3, 7, 9, 11.)

Polyphysa spicata, Kütz. Tab. Phyc. vol. xvi. t. i. fig. 2 (1866).—*Pleiophysa spicata*, Sond. in F. v. Mueller's Fragment. Phytogr. Austr. Suppl. (solum nomen).

Hab. On the shores of New Caledonia, mouth of the River Massioncoué (*Balansa*, no. 2640), Hb. Thuret; on madrepores at Ina, 1863 (*Vieillard*, N. Cal. no. 1961, Hb. Thuret, Berlin; *Vieillard*, N. Cal. no. 13 in Hb. Brit. Mus.).

This species is very similar to the other, but is to be distinguished by the smaller number and the cohering of its calcified spores, which appear in a fresh state like a small fragment of lime of irregularly rounded form. The young plant also has a somewhat different habit, but I have seen it only in a few individuals (*Vieillard*, 1901).

III. CHALMASIA, nov. gen.

Discus fertilis terminalis e radiis liberis incrustatione tantum coalitis formatus. Corona inferior nulla; sporæ liberæ membrana crassa valde incrustata insignes.

Fertile cap terminal, composed of free, wedge-shaped rays, united only by the calcification; corona inferior wanting; segments of the corona superior not touching each other laterally, knob-shaped, and not sharply delimited towards the base; spores free, with thick, much calcified membrane, and coarse cuticularized outer layer.

1. Chalmasia antillana, sp. unica, char. gen.

Cap infundibuliform, rays free, 26–32, with cylindrical basal portion which bears the coronal prominences in the form of an elevated ridge: this has the hair-scars either a pair obliquely or three in a triangle on the laterally compressed point. Sporangium covered externally all round with thin, irregularly outlined, easily detachable flakes of incrustation, vesicular and inflated, cut off at the outer margin, with an obtuse bulging projection: spores filling the whole sporangium, approximately globular, chalk-white from the strong calcification of the membrane.

Size: diam. of cap about 6 mm.; breadth of corona 0·18 mm.; spore diam. (measured after decalcification) 0·15 mm. (Plate III. figs. 2, 3, 5.)

Hab. West Indies (*Agassiz*!). (Hb. Thuret, misit *Farlow*.)

The few specimens of this very remarkable plant unfortunately lack precise localization*. They are besides very imperfect, and consist merely of completely ripe, torn-off fertile whorls, to which is attached a longer or shorter stalk. Its habit is that of Acetabuloides—indeed they were called *A. crenulata*. In the absence of the corona inferior they agree with *Polyphysa*, but in spore-structure completely with *Halicoryne*. On account of the general structure of the fertile shoot, however, the plant cannot well be placed in the latter genus.

IV. ACICULARIA, D'Archiac, in Mém. de la Soc. géol. de France, vol. v. pt. 2 (1843).

Discus fertilis terminalis e radiis inter se conjunctis formatus, coronis et inferiore et superiore præditis, sporæ massa mucosa calce incrustata coalitæ, pro radio spiculam solidam cuneatam formantes.

* Farlow writes to me that he received them from Comte Pourtalès, who accompanied Agassiz on one of his expeditions, and could only obtain this information with them,—that they were dredged south of the coast of Florida.

Clavis Specierum.

a. Forma unica viva .... 1. *A. Schenckii.*

b. Formæ fossiles.

1. Disci fragmenta septis crassissimis cavitatis sporarum subtus et supra biseriatæ.. 2. *A. Andrussowi.*

2. Spiculæ sporigeræ tantum rotæ aciculares.

a. Spicula extus rotundate convexa.. 3. *A. miocenica.*

β. Spicula extus profunde emarginata.. 4. *A. pavantina.*

Fertile whorl terminal, consisting of wedge-shaped rays united laterally with each other ; corona inferior and superior developed, approximately of the same shape ; spores adhering in a cluster from the strong calcification of the outer membranes and filling the whole sporangial ray, through the upper surface of which the spores appear. The calcified substance is a homogeneous slime, in which, after decalcification, no trace can be demonstrated of a cuticuloid layer. In the cavities of this slime-mass are situated the easily detachable spores enclosed within a thin, sharply-contoured membrane with a lid.

a. Living Forms.

1. Acicularia Schenckii, Solms. Unica species adhuc viva, char. gen.

Stalk thin-walled, somewhat stout as if inflated, flabby, with scars of hair-whorls and terminal fertile disc flat or infundibuliform ; rays 30–50, fairly closely united, wedge-shaped, as if cut off straight at the margin, with sharp, somewhat projecting angles, and seated on well-developed vestibules ; segments of the corona superior crowded together, deeply scolloped externally, irregularly bilobed, and with much thickened membrane, bearing two hair-scars, one behind the other ; corona inferior of the same shape ; the lime-spiculæ enclosing the spores obtusely quadrangular in section, pointed inwards, enlarged outwards, and ending in an obtuse arch, on all sides revealing the spores ; incrustation distinctly composed of the lime-layers of the spores, so that each spore-cavity appears to be surrounded by its peculiar ring of lime ; these rings united with each other at the surfaces of contact, and, between them, here and there in the angles, gusset-shaped cavities.

Size : diam. of the disc about 6 mm. ; breadth of corona 0·13 mm. ; spore diam. 0·06 mm. (Plate III. figs. 4, 9, 11, 12, 14, 15.)

Acetabularia Schenckii, Möbius in 'Hedwigia,' vol. xxviii. 1889, p. 318.

Hab. Martinique (misit *Lenormand*, Herb. Berol.) ; Guadeloupe (*Vivier Boissard*, 1860, Herb. Thuret) ; Brazil, Cabo Frio, Prov. Rio de Janeiro. In shallow lagoons, May 1887 (*H. Schenck*, Hb. Schenck). Goebel has recently collected magnificent specimens at Curaçao (Mus. Bot. Monac.).

The specimens I have seen of this interesting species agree in the main in all respects. The specimens from Martinique are distinguished by the great delicacy and fragility of the sporangium-walls, not noticeable to the same degree in the others. This may have arisen from their being collected when over-ripe and beginning to decay, so that it was difficult to obtain for examination a cap that continued to hold together. Fragments of such, and especially beautiful, intact lime-spiculæ, are to be found abundantly in the mass

of mud, small sea-stars, and remains of algæ forming the dried specimen. Schenck's specimens from Cabo Frio in Brazil are, on the other hand, well preserved, and are found on mussel- and snail-shells. If Möbius did not observe the spiculæ and took the plant merely for an *Acetabularia*, it was probably because he examined it only after decalcification.

b. Forms known only in a fossil state.

Of these only the lime-spiculæ with the spores were known for a long time. These, however, are sometimes several together, when also the remains of the partition-walls of the chambers are preserved. But quite recently a form belonging here or to *Chalmasia* with complete caps and fragments was found by Andrussow and described by him as *Acetabularia miocenica*. In placing it in the genus *Acicularia* it cannot retain this specific name, since an *Acicularia miocenica*, Reuss, exists already. It may therefore be called *Acicularia Andrussowi*. The spores have vanished in all cases from the spiculæ of the fossil *Aciculariæ*, and cavities usually opening outwards mark their places. These holes are either equally distributed all round the spiculæ or they are present only on the upper and under surfaces. The species of the former kind are equivalent to d'Archiac's genus *Acicularia*, those of the latter to the genus *Briardina*, Mun.-Chalm., as kindly communicated to me in writing by Munier-Chalmas. I am doubtful whether it be expedient to separate both groups generically on so slight a distinction. From the fragments I have seen and Carpenter's figures I perceive that *Acicularia* contains a large number of fossil species, and among them some of those treated of by Carpenter fall under the type *Briardina* (compare his plate 29. fig. 11). I must refrain from a description of these, owing to the scarcity of material at my command. It is to be hoped that Munier-Chalmas himself will deal with them at no distant date. Only those species can be mentioned here that have obtained a place in the literature of the subject, and it must be expressly stated that their position in the genus *Acicularia*, as understood here, is by no means certainly determined. The mere spiculæ of *Halicoryne* of the type of *H. spicata* would be, were they fossil, indistinguishable from those of a true *Acicularia*, though they come from a plant of wholly different structure, and from the constitution of both the species of *Halicoryne* it appears not to be impossible that at an earlier period there may have existed also *Chalmasiæ* with clustered spores, which in that case would come under the parent genus *Acicularia*.

2. Acicularia Andrussowi, Solms.

Fertile discs circular, flattened, with up to 90 peripheral, very narrow ray-chambers with obtuse ends. The partition-walls dividing the chambers extraordinarily thick, sometimes as broad as the chambers themselves, sometimes a little less. Spore-cavities in two rows on both the upper and under sides of the spicula, filling the chambers. Corona superior and inferior, according to Andrussow, in the form of flat bands. (Plate III. fig. 13.)

Acetabularia miocenica, Andr. In the Miocene (2nd Mediterranean bed) of the Crimea, singly in the Tschokkrak lime of the peninsula of Kertch, rock-forming in white lime with

Ostrea digitalina, *Pecten Gloria-maris*, Bryozoa and Serpulæ in the ravine of Karanj, not far from the Monastery of St. George, south of Sebastopol.

3. ACICULARIA MIOCENICA, Reuss, in Sitzber. d. k. Akad. d. Wissensch., Math.-nat. Cl. Bd. xliii. Abth. 1 (1861), p. 7, figs. 5–8 *d*.

Spicula wedge-shaped, obtusely round at outer margin, pressed flat, consisting of two layers of roundish spore-cavities; spore-cavities on the two sides almost wholly wanting, surrounded by a circular wall.

In the Miocene beds of the district of Vienna (Nussdorf), in the Transylvanian Tegel at Lapugy, in the Salzthon [Permian] of Wieliczka, abundantly in the Leithakalk of Kostel in Moravia.

This species is extremely like the recent *A. Schenckii*, but may be sufficiently distinguished from it by the more flatly compressed spiculæ and the almost total absence of the open spore-cavities on sides of the partition-walls.

4. ACICULARIA PAVANTINA, d'Archiac, Description géologique du Département de l'Aisne, Mém. de la Soc. géol. de France, vol. v. pt. ii. 1843, p. 386, t. 25. fig. 8.

Spicula wedge-shaped, deeply emarginate in two lobes at the outer edge, of round or oval section: spore-cavities narrowing wedge-fashion towards the centre, opening outwards equally all round without a wall-like border.

Michelin, Iconogr. zoophytologique, p. 176, t. 46. fig. 14; Reuss, loc. cit. figs. 1–4. *Ovulites Pavantina*, d'Orbigny, Prodr. de Paléont. stratigraphique, ii. p. 405, no. 1292; Pictet, Traité de Pal. édit. ii. vol. iv. p. 484; Bronn, Lethæa geognostica, ed. iii. vol. iii. p. 259.

In the Eocene of the Paris basin; Grobkalk [Middle Eocene] of Pisseloupe at Pavant, Étréchy at Étampes.

In the characters described this species departs from the recent species much more than *A. miocenica*. With reference to the peculiar pointed converging form of the spore-cavities I am unable to express an opinion, since I have seen only one complete spicula in the possession of Prof. Steinmann, of Freiburg, and I have not seen cross fractures.

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Strassburg, Jan. 29, 1893.

EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1. *Acetabularia crenulata,* Lamour. The fertile shoot with several caps cut in half vertically; on the corona of the highest the branched hairs still remain. Between each two caps there is a whorl of scars which had borne a sterile crown of hairs. Slightly magnified.

2. Ditto. Apical view of the corona superior, with two hair-scars, one behind the other, on each portion. ×.

3. Ditto. Longitudinal section of a ray of the cap, showing the vestibule and the prominences of the coronæ superior and inferior, the former provided with hair outgrowths : *a,* the central portion of the disc : *b,* the sporangium. ×.

4. *Acetabularia mediterranea,* Lamour. Longitudinal section of a cap during development. At *a* the globular, raised apex of the shoot ; at *v* the vestibule, of which the partition-wall towards the ray has been formed ; at *b* the portion of the corona superior with developing hairs, below which, and without doubt laterally, the sporangium *c* begins to shoot out. ×.

5. Ditto. Longit. section through a ray of an almost mature cap, showing vestibule, coronæ superior and inferior : *a,* the central portion of the disc ; *b,* the sporangium. ×.

6. *Acetabularia Kilneri,* Agardh. Side view of two cap-rays, showing the peculiar thickenings characteristic of the species. ×.

7. *Acetabularia mediterranea,* Lamour. Longit. section of young cap during development of sporangium. This (*a*) has already pressed the apex and the portion of the corona superior into a lateral position ; *b,* the corona superior ; *c,* the central portion of the disc. ×.

8. Ditto. Longit. section of a very young cap which scarcely shows the differentiation of corona and sporangium. ×.

9. *Acetabularia Suhrii,* Solms. Corona superior from above. ×.

10. *Acetabularia caraibica,* Kütz. End of sporangial ray filled with spores. ×.

11. *Acetabularia dentata,* Solms. Ends of two cap-rays. ×.

12. *Acetabularia mediterranea,* Lamour. External view of the cap during development. (From the same specimen as fig. 8.) ×.

13. *Acetabularia Suhrii,* Solms. Disc seen from below : at *a,* the vestibule ; at *b,* the corona inferior ; at *c,* the sporangia.

PLATE II.

Fig. 1. *Acetabularia exigua,* Solms. Side view of a complete decalcified specimen. ×.

2. *Acetabularia Peniculus,* R. Br. Longit. section of a specimen with two caps, one above the other ; of which the lower one is anomalous in producing on its branches secondary caps of more or less completeness ; *a* represents their sporangia. ×.

3. *Acetabularia parvula,* Solms. View of the corona superior from above. ×.

4. *Acetabularia exigua,* Solms. View of the cap from above. Only the bases are drawn of the sporangia and of the hairs in the coronal prominences. ×.

5. *Acetabularia parvula,* Solms. Cap seen from above, showing the abundant calcification of the partitions between the rays. ×.

6. *Acetabularia Peniculus*, R. Br. Longit. section of a ray: *b*, the vestibule; *c*, the central portion of the disc; *d*, the coronal process with one of the two transversely placed hair-scars; *a*, the sporangium. ×.
7. Ditto. A cap-ray seen from above; lettering as in fig. 6. ×.

Plate III.

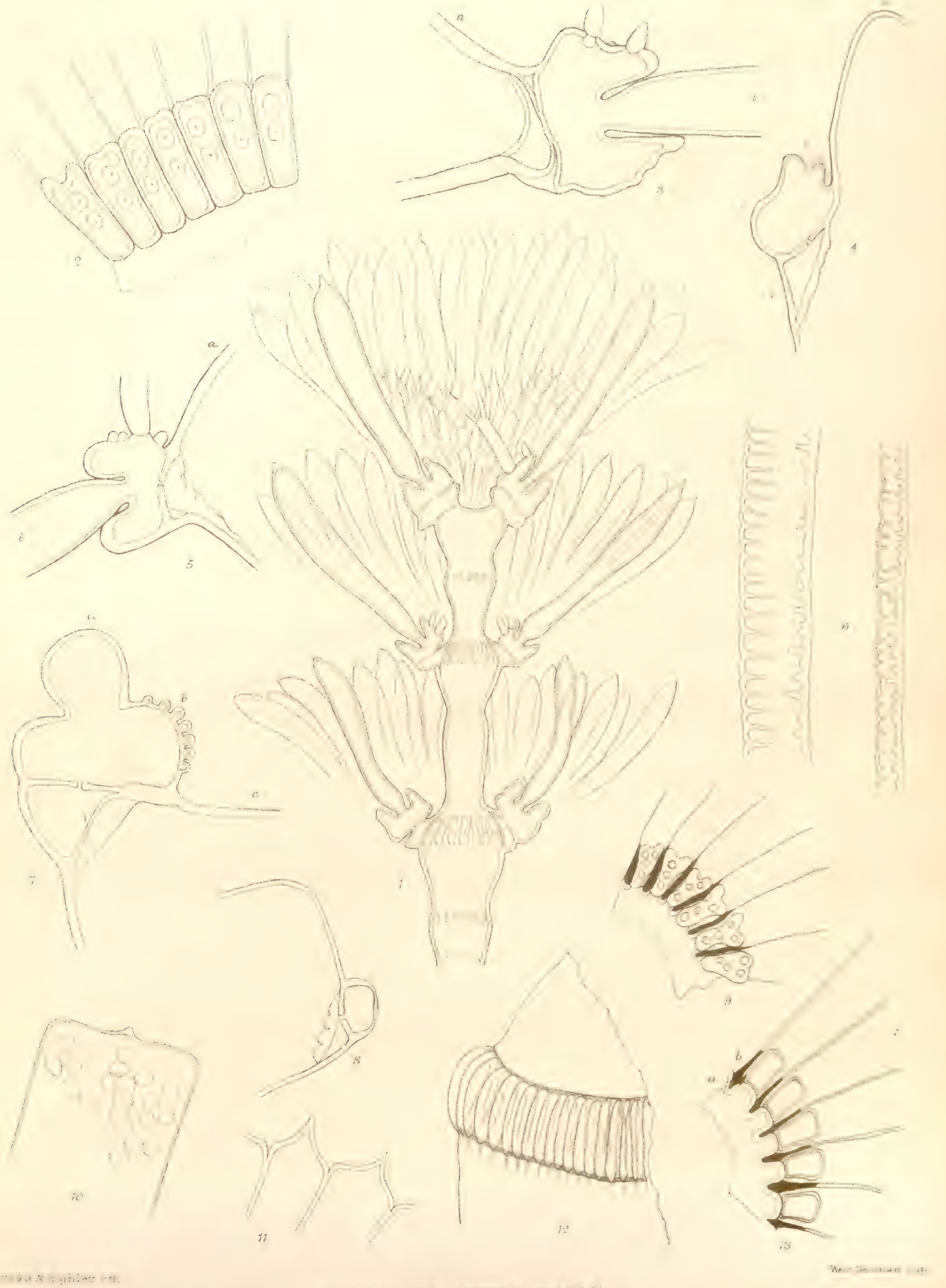
Fig. 1. *Acetabularia Farlowii*, Solms. View of the fertile cap. ×.
2. *Chalmasia antillana*, Solms. View of the corona superior from above. ×.
3. Ditto. View of the cap. ×.
4. *Acicularia Schenckii*, Möbius. View of the corona inferior from lower side of cap; at *a* transverse section of the stalk. ×.
5. *Chalmasia antillana*, Solms. A cap-ray in profile: *a*, the cut-off sporangium; *b*, the coronal prominences; *c*, the central portion of the disc. ×.
6. *Acetabularia Calyculus*, Quoy et Gaimard. Profile view of cap-ray full of spores: *a*, the sporangium; *b*, the corona superior; *c*, the corona inferior; *d*, longit. section of wall of stalk. ×.
7. Ditto. View of corona superior from above. ×.
8. *Acetabularia exigua*, Solms. Emptied gametangia, showing the lid apart. ×.
9. *Acicularia Schenckii*. Fragments of spore bearing lime-spicula: in several spores the lid is visible as a circular line. ×.
10. *Acetabularia Calyculus*, Quoy et Gaim. Part of cap from below, showing the corona inferior. ×.
11. *Acicularia Schenckii*, Möbius. Profile view of cap-ray. ×.
12. Ditto. View from above of corona superior. ×.
13. *Acicularia Andrussowii*, Solms. Surface view of the marginal portion of a fertile cap; in each chamber a lime-spicula with two rows of spore-cavities. ×.
14. *Acicularia Schenckii*, Möbius. View of group of plants growing on a shell—brought from Brazil by Schenck.
15. Ditto. Uninjured lime-spicula from the cap-ray, with its spore-cavities. ×.

Plate IV.

Fig. 1. *Acetabularia Möbii*, Solms. Longit. section of a specimen with two superposed caps. From a spirit-specimen collected by Möbius at Mauritius. ×.
2. *Acetabularia polyphysoides*, Crouan. Side view of the corona superior. ×.
3. *Halicoryne spicata*, Kütz. Chalk-spicula containing spores taken out of sporangium. ×.
4. *Halicoryne Wrightii*, Harv. Profile view of the fertile whorl: *a*, the sporangium; *b*, the coronal prominences; *c*, the basal portion.
5. Ditto. View of the apical region of a young plant from a dried specimen (from Mactan, Philippines, collected by 'Challenger' Expedition) in the British Museum. Sterile hair-bearing and fertile whorls regularly alternating. The hair-whorls situated above are not drawn in so as to permit the main axis to appear. This terminates in a cupola-like apex above the youngest hair-whorl.
6. *Acetabularia polyphysoides*, Crouan. Profile view of a cap-ray from a dried plant (whence the collapse of the sporangium); *a a b*, corona superior: *c*, the central portion of the disc. ×.
7. *Halicoryne spicata*, Kütz. Single spore after decalcification, showing the thick stratified cell-membrane and the lid. ×.

8. *Halicoryne Wrightii,* Harv. Transverse section of the spore-membrane through the edge of the lid, after careful decalcification, drawn without a prism and very strongly magnified.
9. *Halicoryne spicata,* Kütz. Fragment of a fertile whorl with two complete rays, of which one, *a*, is seen obliquely from the side, the other, *b*, from above. ×.
10. *Halicoryne Wrightii,* Harv. Similar view as fig. 4; same lettering.
11. *Halicoryne spicata,* Kütz. Basal portion of a ray from a fertile whorl with a hair-rudiment, *a*, preserved, marking the position of the coronal prominence, which is not visible.

[*Note to* p. 12.—Whilst this paper was passing through the press, I received from Professor Cramer a memoir on *Halicoryne Wrightii* [7] in which the facts are correctly stated, so far as the yet unfruiting plant is concerned. He found solitary dichotomously-branched hairs on the coronal prominences; in my specimens these were all uniformly reduced to small unbranched processes.—*May* 20, 1895.]



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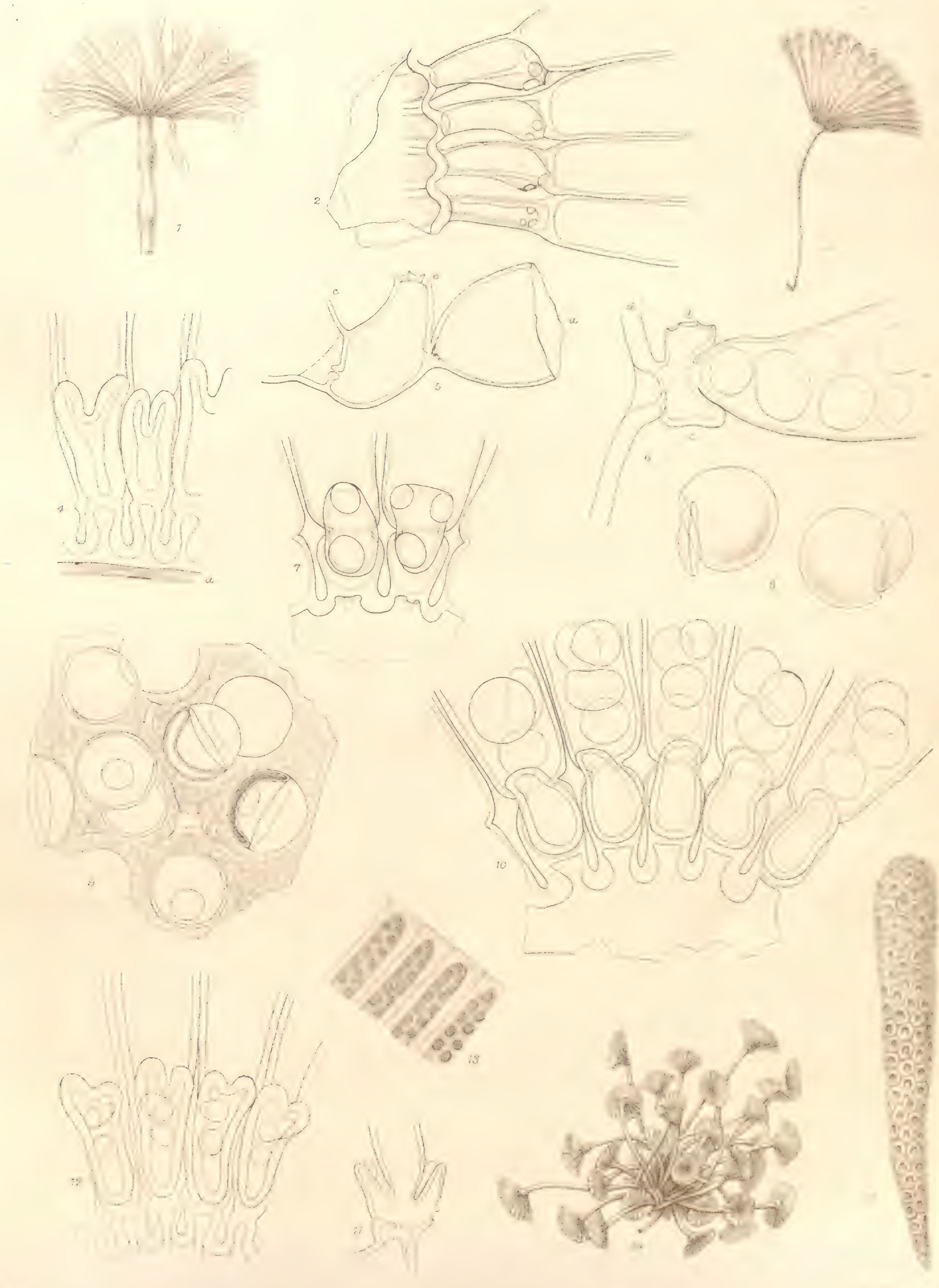

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OF

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THE FRESHWATER ALGÆ OF MADAGASCAR.

BY

WILLIAM WEST, F.L.S., AND GEORGE S. WEST, A.R.C.S., &c.

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October 1895.

II. *A Contribution to our Knowledge of the Freshwater Algæ of Madagascar.* *By* WILLIAM WEST, *F.L.S., and* GEORGE S. WEST, *A.R.C.S., Scholar-elect of St. John's College, Cambridge.*

(Plates V.–IX.)

Read 1st February, 1894.

BY the kindness of the Rev. R. Baron, of Antananarivo, we have been enabled to examine a number of gatherings of Algæ from that district which he has most obligingly collected at the request of one of us. The result is very pleasing, as many new and interesting species have thus been revealed, and considerable additional knowledge of the distribution of known forms has been attained. The naming of the Diatoms has been left to a future occasion. The *Cosmaria* are particularly fine and noteworthy.

It will be noticed that the larger Algæ are hardly represented; this is due to the fact that these tentative collections were made chiefly with the view of securing the smaller forms.

The number after each species corresponds to the particular locality from which it was obtained. With the exception of one number, we do not at present know the corresponding localities, but hope to give them at some future date (see Note on p. 90):

No. 36. Mud from the bottom of Lake Alastra (a yard deep).

Summary of Genera, Species, and Varieties.

Orders.	Genera.	Species.	Varieties and Forms.
Coleochætaceæ	1	1	
Œdogoniaceæ	2	5	
Zygnemaceæ	1	3	
Desmidiaceæ	12	145	32
Pediastreæ	1	4	1
Sorastreæ	2	2	
Eremobiæ	2	4	
Protococcaceæ	4	10	9
Rivulariaceæ	1	1	
Scytonemaceæ	1	1	
Sirosiphoniaceæ	1	1	
Oscillariaceæ	1	1	
Chroococcaceæ	2	3	
Total	31	181	42

Class *CONFERVOIDEÆ HETEROGAMÆ.*

Order COLEOCHÆTACEÆ.

Genus Coleochæte, Bréb.

1. Coleochæte irregularis, Pringsh. Jahrb. für wissensch. Botan. ii. (1860) t. i. fig. 6, t. vi. figs. 3–9; Rabenh. Fl. Europ. Alg. iii. p. 390.
No. 3.

Order ŒDOGONIACEÆ.

Genus Bulbochæte, Ag.; Pringsh.

2. Bulbochæte, sp.
Crass. cell. veget. 21–23 μ; altit. $1\frac{1}{2}$–2-plo major.
No. 3.

Genus Œdogonium, Link; Pringsh.

3. Œdogonium, sp.
Crass. cell. veget. 13·5–15 μ; altit. 7-plo major.
No. 5.

4. Œdogonium, sp.
Crass. cell. veget. 11·5–13·5 μ; altit. 2–3-plo major.
No. 5.

5. Œdogonium, sp.

Crass. cell. veget.	7–8·5 μ;	altit.	$4\frac{1}{2}$–8-plo major;
,, oogon.	28 μ;	,,	32 μ;
,, oospor.	22 μ;	,,	22 μ.

Nos. 0, 1, and 10.

6. Œdogonium, sp.
Crass. cell. veget. 2·5–3 μ; altit. 6–8-plo major.
No. 3.

Class *CONJUGATÆ.*

Order ZYGNEMACEÆ.

Genus Spirogyra, Link.

7. Spirogyra decimina, Kütz. Phycolog. Germ. p. 223; Tabulæ Phycolog. v. pl. xxiii. fig. 3 et pl. xxiv. fig. 1; Petit, Spirogyra des Environs de Paris, p. 25, pl. viii. figs. 1–3.

Crass. cell. veget. 38–48 μ; longitudo diametro 2–4-plo longior; long. zygosp. 73–75 μ; lat. zygosp. 40–49 μ.

No. 18.

8. Spirogyra, sp.

Cellulæ diametro (32–34·5 μ) 5–7-plo longiores, extremitatibus nunquam replicatis, fasciis spiralibus 2, anfractibus 6–7.

No. 5.

9. Spirogyra, sp.

Cellulæ diametro (13–5 μ) 8–10-plo longiores, extremitatibus nunquam replicatis, fasciâ spirali, anfractibus 6.

No. 1.

Order DESMIDIACEÆ.

Genus Spondylosium, Bréb.

10. Spondylosium papillosum, nov. sp. (Pl. IX. fig. 19.) *S.* filis tortis, sine vaginâ mucosâ; cellulæ paullo longiores quam latæ, modice constrictæ, sinu aperto et obtuso; semicellulæ ellipticæ, apicibus truncatis, lateribus granulis 3 minutissimis instructis, a latere visæ subcirculares.

Long. cell.=lat.=9·5 μ; lat. isthm. 5·5 μ; crass. 5 μ.

No. 3.

This is nearest to *Spondylosium tetragonum*, West (Freshw. Alg. of W. Ireland, p. 115, pl. xx. fig. 2), but the cells are much more constricted and have three very minute lateral granules.

Genus Desmidium, Ag.

11. Desmidium Swartzii, Ag. Syst. Alg. p. 9; Ralfs, Brit. Desm. p. 61, tab. iv.

Var. amblyodon, Rabenh. Fl. Europ. Alg. iii. p. 154.

Long. cell. 15·5 μ; lat. cell. 30 μ; lat. isthm. 25 μ. (Pl. IX. fig. 35.)

No. 0.

Var. quadrangulatum, Roy (Scottish Desmids, 1893). (*Desmidium quadrangulatum*, Ralfs, in Annals of Natural History, vol. xv. p. 405, t. 12. fig. 9; Brit. Desm. p. 62, tab. v.)

Long. cell. 17–19 μ; lat. ad bas. semicell. 32–40 μ; lat. apic. 30–36 μ; lat. isthm. 26 μ. (Pl. IX. fig. 34.)

No. 0.

The specimens observed of this variety had very rounded angles, as in var. *amblyodon*, Rabenh., with which it agreed in all characters except the quadrangular vertical view.

12. Desmidium Baileyi, De Bary, Conj. p. 76; Nordst. Alg. et Char. i. p. 4. *Aptogonum Baileyi*, Ralfs, Brit. Desm. p. 208, tab. xxxv. fig. 1.)

α. genuina, Nordst. Freshw. Alg. of New Zeal. & Austr. p. 27, tab. ii. figs. 4, 5.

Long. cell. 18·5 μ; lat. 19–24 μ. (Pl. IX. fig. 36.)

No. 0.

This is a tetragonal form and approaches var. *indicum*, W. B. Turn. (Freshw. Alg. of E. India, p. 149, tab. xix. fig. 5).

Genus Docidium, Bréb.

13. Docidium Baculum, Bréb. in Ralfs, Brit. Desm. p. 158, tab. xxxiii. fig. 5.

Long. 238 μ; lat. ad bas. semicell. 10 μ; lat. med. semicell. 9·5 μ; lat. apic. 6 μ. (Pl. V. fig. 30.)

Nos. 0 and 1.

14. Docidium manubrium, nov. sp. (Pl. V. fig. 31.) *D.* mediocre, circiter diametro 13-plo longius; semicellulæ attenuatæ, undulis duabus parvis prope basin, granulis 16 in circumferentiâ baseos (visis 9), lateribus rectis, apicibus truncatis; membranâ irregulariter punctatâ.

Long. 384 μ; lat. ad bas. semicell. 31 μ; lat. ad apic. 19 μ.

No. 0.

This species has the characteristic basal plications present in other members of this genus, viz.:—*D. Baculum*, Bréb., *D. dilatatum*, Lund., and *D. nobile*, Lund.

Genus Pleurotænium, Näg.

15. Pleurotænium subcoronulatum. (*Docidium subcoronulatum*, W. B. Turn. Freshw. Alg. of E. India, p. 29, tab. iii. fig. 1.)

Long. 407–453 μ; lat. ad bas. semicell. 29–37 μ; lat. apic. 25–29 μ. (Pl. V. fig. 33.)

No. 0.

16. Pleurotænium ligatum, nov. sp. (Pl. V. fig. 42.) *P.* magnum, diametro circiter 14-plo longius, in medio modice constrictum (lat. constrict. 33 μ); semicellulæ sine inflatione basali, lateribus parallelis apices versus subattenuatæ et constrictæ, apicibus truncatis, tuberculis oblongo-ellipticis parvis 34 (visis 18) instructis; membranâ irregulariter et minute punctatâ.

Long. 614 μ; lat. ad med. semicell. 44 μ; lat. juxta apicem 32 μ.

No. 0.

17. Pleurotænium moniliferum, nov. sp. (Pl. V. fig. 32.) *P.* magnum, diametro circiter 15-plo longius; semicellulæ levissime attenuatæ, sine inflatione basali,

lateribus rectis, apicibus truncatis, leviter expansis, tuberculis sphæricis 26 (visis 14) instructis; membranâ punctatâ.

Long. 645 μ; lat. ad bas. semicell. 45 μ; lat. juxta apic. 41 μ.

No. 0.

This species differs from *Pleurotænium orientale* [=*Docidium orientale*, W. B. Turn. l. c. p. 31, tab. iv. fig. 1] in wanting the basal inflation, in its straight sides, and in the fewer apical tubercles.

18. Pleurotænium parallelum, nov. sp. (Pl. V. fig. 34.) *P.* magnum, diametro circiter 18-plo longius; semicellulæ inflatione basali, supra partem basalem levissime uni-undulatæ, lateribus rectis et parallelis, apicibus truncatis, tuberculis 26 (visis 14) sphæricis parvis intra marginem apicis instructis; membranâ irregulariter et minute punctatâ.

Long. 724 μ; lat. ad bas. semicell. 48 μ; lat. ad apic. 36 μ.

No. 0.

This differs from *P. orientale* in the parallel sides, in not having the apices expanded and with fewer tubercles, which are *within* the margin. It differs from *P. moniliferum* (n. 17) in its apex and basal inflations.

19. Pleurotænium firmum, nov. sp. (Pl. V. fig. 41.) *P.* magnum, crassum, diametro circiter 8-plo longius; semicellulæ cum inflatione parvâ basali, lateribus subparallelis, apices versus subito attenuatæ, apicibus subtruncatis, tuberculis oblongis parvis 32 (visis 17) intra marginem apicis instructis; membranâ dense scrobiculatâ.

Long. 560 μ; lat. ad bas. semicell. 75 μ; lat. ad med. semicell. 73 μ; lat. ad apic. 48 μ.

No. 0.

20. Pleurotænium Ehrenbergii, De Bary, Conj. p. 75. (*Docidium Ehrenbergii*, Ralfs, Brit. Desm. p. 157, tab. xxvi. figs. 4 *a*, *b*, *c*.)

Long. 296–303 μ; lat. ad bas. semicell. 19–21 μ; lat. ad apic. 13·5 μ.

Nos. 0 and 1.

Forma semicellulis plus attenuatis, inflatione basali majore.

Long. 338 μ; lat. ad bas. semicell. 35·5 μ; lat. ad apic. 17·5 μ. (Pl. V. fig. 40.)

No. 22.

This is similar in form to *P. quantillum* [=*Docidium quantillum*, W. B. Turn. Freshw. Alg. of E. India, p. 28, tab. ii. fig. 9, and tab. iv. fig. 12], but is much larger.

21. Pleurotænium basiundatum, nov. sp. (Pl. V. fig. 35.) *P.* mediocre, elongatum, diametro circiter 26-plo longius; semicellulæ vix attenuatæ, cum inflatione rotundâ magnâ in basi, et undulis 4–5 supra sensim et gradatim minoribus pæne medio tenus instructis, apicibus truncatis et subincrassatis; membranâ sparsim scrobiculato-punctatâ.

Long. 517 μ; lat. ad bas. semicell. 24 μ; lat. ad apic. 13·5 μ.

No. 0.

The undulations above the larger basal inflation are much less elevated and not so rounded. Compare with *Pleurotænium truncatulum* [=*Docidium truncatulum*, W. B. Turn. l. c. p. 32, tab. iv. fig. 10] and *P. baculiforme* [=*Docidium baculiforme*, W. B. Turn. l. c. p. 33, tab. iv. fig. 15].

Genus Closterium, Nitsch.

22. Closterium lanceolatum, Kütz. Phycolog. German. p. 30; Ralfs, Brit. Desm. p. 164, tab. xxviii. fig. 1).

Long. 383–475 μ; lat. 55–58 μ. (Pl. IX. fig. 21.)

No. 5.

23. Closterium pachydermum, nov. sp. (Pl. V. fig. 37.) *C.* permagnum, diametro circiter 27-plo longius, modice curvatum, subrectum in medio, sensim et gradatim attenuatum apices truncatos curvatiores versus; membranâ crassissimâ, achroâ, glabra.

Long. 770 μ; lat. 28 μ; lat. apic. 8 μ; crass. membr. μ.

No. 0.

This species is nearest to *C. subangustatum*, West (Freshw. Alg. of Maine, Journ. Bot. Dec. 1891, t. 315. figs. 3, 4), in general outline and curvature, but differs in its very thick unstriated and colourless membrane.

24. Closterium Leibleinii, Kütz. Synops. Diatom. in Linnæa, 1833, p. 596; Ralfs, Brit. Desm. p. 167, tab. xxviii. fig. 4.

Forma apice crassior quam forma typica.

Lat. 25 μ. (Pl. V. fig. 38.)

No. 0.

25. Closterium Pseudodianæ, Roy (Desm. Alford District, in Scott. Nat. Jan. 1890; icon. in lit.).

Forma brevior et minus attenuata.

Long. 100 μ; lat. 9 μ. (Pl. V. fig. 39.)

No. 0.

26. Closterium lagoense, Nordst. Desm. Brasil. tab. ii. fig. 2.

Var. læve, nov. var. (Pl. IX. fig. 20.) Var. cellulis apices versus paullo crassioribus; membranâ non striatâ.

Lat. 23 μ; apicibus 116 μ inter se distantibus.

No. 0.

27. Closterium Kützingii, Bréb. Liste Desm. p. 156, t. ii. fig. 40; Nordst. Freshw. Alg. of New Zeal. & Austr. p. 70, tab. iii. fig. 20.
Lat. 11 μ; striis 7 in 10 μ.
No. 1.

28. Closterium setaceum, Ehrenb.; Ralfs, Brit. Desm. p. 176, tab. xxx. fig. 4.
No. 0.

Genus Penium, Bréb.; De Bary.

29. Penium curtum, Bréb. in Kütz. Spec. Alg. p. 167. (*Cosmarium curtum*, Ralfs, Brit. Desm. p. 109, tab. xxxii. fig. 9.)

Forma intermedia, Wille, Ferskv. Alg. f. Nov. Seml. p. 56, t. xiv. fig. 74.
Long. 36 μ; lat. 15·5 μ.
No. 0.

30. Penium delicatulum, Josh. Burmese Desm. in Journ. Linn. Soc., Bot. vol. xxi. 1886, p. 653, t. 25, figs. 9–10.

Var. minor, nov. var. (Pl. V. fig. 36.) Var. duplo minor, membranâ densâ et delicatissime punctatâ.
Long. 37·5 μ; lat. 15·5 μ.
No. 1.

31. Penium minutissimum, Nordst. Bidrag till kännedom sydligare Norges Desm. p. 46, fig. 21.
Long. 11·5 μ; lat. 8 μ.
No. 0.

32. Penium, sp.
Long. 21 μ; lat. 11·5 μ. (Pl. V. fig. 29.)
No. 1.

33. Penium, sp.
Long. 20 μ; lat. 10 μ. (Pl. V. fig. 28.)
No. 0.

Genus Cylindrocystis, Menegh.

34. Cylindrocystis tumida, F. Gay, Essai Monogr. Conj. p. 52, t. i. fig. 1.
Forma membranâ minutissime punctatâ.
Long. 89 μ; lat. 27·5 μ.
No. 1.

35. CYLINDROCYSTIS CRASSA, De Bary, Conj. p. 74; Cooke, Brit. Desm. p. 46, pl. 18, fig. 2.

Var. ELLIPTICUM, nov. var. (Pl. V. fig. 27.) Var. latior, lateribus valde convexis.
Long. 35 μ; lat. 29 μ.
No. 0.

Genus MICRASTERIAS, Ag.

36. MICRASTERIAS PINNATIFIDA, Ralfs, Brit. Desm. p. 77, tab. x. fig. 3. (*Euastrum pinnatifidum*, Kütz. Phycolog. Germ. p. 134.)

Var. INCUDIFORMIS, nov. var. (Pl. VI. fig. 5.)
Var. tam longa quam lata; lobo polari in parte inferiore cylindrico, partis superioris lobulis attenuatis unidentatisque; membranâ dense punctatâ.
Long. 62–63·5 μ; lat. 63 μ; lat. isthm. 11·5 μ.
No. 1.

37. MICRASTERIAS CRUX-MELITENSIS, Ralfs, Brit. Desm. p. 73, tab. ix. fig. 3. (*Euastrum Crux-Melitensis*, Ehrenb. in Abhandl. Berl. Akad. p. 81, ex p. Kütz. Phycolog. Germ. p. 134.)

Var. EVOLUTA, W. B. Turn. Freshw. Alg. of E. India, p. 92.
Long. 94 μ; lat. 84 μ; long. dent. apic. 3 μ. (Pl. VI. fig. 1.)
No. 1.

38. MICRASTERIAS MAHABULESHWARENSIS, Hobson, Notes on Indian Desm. in Quart. Journ. Micr. Sc. 1863, p. 168; Lundell, Desm. Suec. p. 15, tab. i. fig. 6.

Var. TETRACERUM, nov. var. (Pl. VI. figs. 2–4.) Var. lobulis brevioribus et crassioribus, denticulis minoribus et paucioribus, apicibus truncatis tridenticulatis; lobo polari a processibus duobus horizontalibus et *processibus quatuor ad apicem* ornatis; tumore centrali a seriebus granulorum non semper intra marginem sed seriatim tumore centrali tenus granulato.
Long. sine proc. 134–138 μ; lat. 106–119 μ; lat. isthm. 25–30 μ.
No. 0.

This belongs to the "*B. compacta*" section of Nordst. (Freshwater Algæ of New Zealand and Australia, p. 31), but the doubling of the two smaller apical processes distinguishes it from all other varieties of the species. Fig. 4 shows an abnormally developed semicell.

Genus EUASTRUM, Ehrenb.

39. EUASTRUM BELLUM, Nordst. Desm. Brasil. tab. ii. fig. 6.

Var. MADAGASCARIENSE, nov. var. (Pl. VI. fig. 7.) Var. minor; semicellulæ a fronte visæ angulis inferioribus unidentatis, angulis superioribus dentibus nonnullis intra angulos additis, lobo polari truncato (non emarginato) dentibus nonnullis intra apicem additis, annulo granulorum 8 ad medium et granulis 3 in formam trianguli utrobique appropinquatis; a vertice visæ polis non capitatis, lobo polari subquadrato lateribus subrectis.

Long. 54 μ; lat. ad bas. semicell. 33 μ; lat. max. 44 μ; lat. lob. pol. 13 μ; lat. isthm. 7·7 μ; crass. 21 μ.

No. 0.

40. EUASTRUM HYPOCHONDROIDES, nov. sp. (Pl. VI. fig. 8.) *E.* $1\frac{1}{4}$-plo longius quam latum, medio profundissime constrictum, sinu lineari extremo ampliato; semicellulæ trilobæ, lobis lateralibus rotundo-ovatis margine superiore rotundatiore, granulis acutis magnis irregulariter dispositis, lobo polari elongato-quadrato, apice convexo-truncato granulis acutis irregulariter ordinatis, annulo granulorum 10 et 3 vel 4 intra annulum in medio sitorum; semicellulæ a vertice visæ oblongæ utroque polo subcapitato et granulato, medio utrobique tumore granulato præditæ, lobo polari elliptico-rotundato granulato, a latere visæ obcuneatæ tumore basali, lateribus subconcavis et apicibus convexo-truncatis præditæ.

Long. 49–52 μ; lat. 37–41 μ; lat. lob. pol. 12·5–13·5 μ; lat. isthm. 9·5 μ; crass. 16 μ.

No. 1.

The nearest species to this is *E. sphyroides*, Nordst. (Freshw. Alg. of N. Zeal. & Austr. p. 32, pl. iii. fig. 3), from which it differs in its larger size, its longer lobes with more granules, which are larger and more acute and which also cover the whole of the apical portion of the polar lobe. In the vertical view it differs in the subcapitate poles and the rounded central inflation, and in the lateral view it is comparatively longer. It differs from *E. hypochondrum*, Nordst. (De Alg. et Char. i. p. 8, t. xvi. fig. 11) in its front view by its shorter lateral lobes with larger irregularly disposed granules, in its subrectangular basal angles, and its longer and convex polar lobes. The vertical view differs in having each pole subcapitate, and in the polar lobe being rounded-elliptical (not quadrate-oblong) with fewer and larger scattered granules.

Var. IRREGULARIUS, nov. var. (Pl. VI. fig. 9.) Var. granulis acutioribus longioribusque etiam plus irregulariter dispositis (3–4 associatis).

Long. 50 μ; lat. 39 μ; lat. lob. pol. 13·5 μ; lat. isthm. 9·5 μ.

No. 0.

41. EUASTRUM, n. sp. (Pl. VI. fig. 10.) *E.* semicellulis a vertice visis elliptico-fusiformibus, polis subacutis, spinis brevibus ornatis, in medio utrobique inflatione

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granulatâ, lobo polari oblongo-rectangulari, polis subprofunde et late emarginatis, lateribus convexis, granulis parvis præditis.

Lat. 61 μ; crass. 27 μ; lat. lob. pol. 17 μ; crass. lob. pol. 11·5 μ.

No. 36.

The vertical view of this apparently new *Euastrum* was the only one seen; an unsuccessful attempt was made to obtain the other views.

42. Euastrum sympageum, nov. sp. (Pl. VI. fig. 11.) *E.* mediocre, $1\frac{3}{4}$-plo longius quam latius, elliptico-oblongum, in medio profunde constrictum, sinu angusto-lineari extremo ampliato; semicellulæ pyramido-ovatæ, trilobæ, incisuris lateralibus brevibus et angustis; lobis lateralibus leve concavis, angulis inferioribus truncato-emarginatis, angulis superioribus interdum rotundatis; lobo polari latissime pyramidato, utrobique truncato-emarginato, apice subretuso; semicellulæ tumore singulo intra angulum unumquemque loborum lateralem et apicalem, uno infra polum et papillis binis, 4 submedianis: a vertice visæ ellipticæ, lateribus 4-undulatis (medianis duabus majoribus), lobo polari elliptico lateribus 3-undulatis; a latere visæ ovatæ lateribus biundulatis, apicibus rotundatis, angulis superioribus loborum lateralium tricrenatis; membranâ irregulariter punctatâ.

Long. 56–58 μ; lat. bas. semicell. 32–33 μ; lat. lob. pol. 25–26·5 μ; lat. isthm. 8·5–9 μ; crass. 19·5 μ.

Nos. 0 and 1.

This bears a considerable resemblance to *E. subintegrum*, Nordst. (Desm. Brasil. t. ii. fig. 8), but is proportionately longer and with comparatively parallel sides; it has a different polar lobe, the lateral lobes of the semicells are less concave and of different form, and the lateral and vertical views differ much.

43. Euastrum ansatum, Ralfs, Brit. Desm. p. 85, tab. xiv. fig. 2; Näg. Gattung. einzell. Alg. p. 122, t. vii. D. fig. 3.

Long. 80 μ; lat. 41 μ; lat. apic. 19 μ; lat. isthm. 12·5 μ. (Pl. IX. fig. 17.)

No. 0.

Var. pyxidatum, Delp. Specim. Desm. Subalp. p. 91, t. 6. figs. 32–34. Forma apice latiore quam in formâ typicâ. (Pl. IX. fig. 18.)

Long. 65 μ; lat. 32 μ; lat. apic. 17 μ; lat. isthm. 10 μ; crass. 20 μ.

No. 0.

44. Euastrum obesum, Josh. Burm. Desmid. p. 638, t. xxiii. figs. 19, 20.

Var. subangulare, nov. var. (Pl. VI. fig. 15.) Var. apicibus subquadratis et latioribus; membranâ glabrâ.

Long. 77 μ; lat. 41 μ; lat. apic. 22 μ; lat. isthm. 12·5 μ.

No. 0.

45. Euastrum spinulosum, Delp., africanum, Nordst. De Alg. et Char. i. p. 9, t. xvi. fig. 16.

No. 0.

Var. duplo-minor, nov. var. (Pl. VI. fig. 13.) Var. duplo-minor; semicellulæ a fronte visæ granulis minoribus nonnullis additis medium versus, incisuris angustioribus et lobo polari latissime cuneato.

Long. 42 μ; lat. 38 μ; lat. isthm. 11·5 μ; crass. 23 μ.

No. 0.

Forma submajor, lobis polaribus late subcuneatis. (=*E. sculptum*, Turn. Freshw. Alg. of E. India, p. 87, t. viii. fig. 32.)

Long. 42 μ; lat. 36·5 μ; lat. isthm. 13·5 μ; crass. 22 μ. (Pl. VI. fig. 12.)

No. 0.

46. Euastrum monocyclum, Racib. Nonn. Desm. Polon. p. 38. (*E. gemmatum*, Bréb., *monocyclum*, Nordst. Alg. et Char. i. p. 8, t. xvi. fig. 13.)

Var. polonicum, Racib. l. c. tab. iv. fig. 6.

Long. 52 μ; lat. 38 μ; lat. lob. pol. 16 μ; lat. isthm. 10 μ.

No. 0.

Var. æquilobum, nov. var. (Pl. VI. fig. 14.) Var. semicellulis lobis subæqualibus granulis acutis numerosioribus minoribusque; a vertice visis lobo polari modice constrictis.

Long. 54 μ; lat. 46 μ; lat. lob. pol. 26 μ; lat. isthm. 11·5 μ; crass. 24·5 μ.

No. 0.

47. Euastrum rostratum, Ralfs, Ann. Nat. Hist. vol. xiv. 1844, p. 192, t. 7. fig. 5; Brit. Desm. p. 88, tab. xiv. fig. 6.

*umbonatum, nov. subsp. (Pl. VI. fig. 16.) *E.* mediocre, circiter 1⅝-plo longius quam latum, in medio profunde constrictum, sinu lineari extremo subampliato; semicellulæ trilobæ, incisuris lateralibus latis et apertis; lobis lateralibus profunde sed obtuse emarginatis, lobulis rotundo-truncatis tridenticulatis; lobo polari subrectangulari, apice rectangularo-convexi incisurâ profundâ medianâ, angulis superioribus in spinam productis; semicellulæ tumore mediano, granulis 3–4 intra angulis basalibus, utrobique infra basin incisuræ apicalis granulo magno conico, a vertice visæ ellipticæ, polis rotundatis denticulatis, in medium utrobique umbone conico-obtuso, a latere visæ ovato-conicæ, lateribus subconcavis circiter medium granulis magnis conicis instructis.

Long. 54–56 μ; lat. 32·5–34·5 μ; lat. lob. polar. 18–19 μ; lat. isthm. 8·5–9·5 μ; crass. 23·0–24·5 μ.

Nos. 0 and 1.

It differs from *Euastrum rostratum*, Ralfs, var. *præmorsum*, Nordst. (Freshw. Alg. of New Zeal. & Austr. p. 34, pl. iii. fig. 7), in the median projection not being truncate, in the absence of the scrobiculæ, in being more denticulate, as well as in the distinct median papilla of the lateral view; the poles of the vertical view are also rounded and not truncate.

Var. ORNATUM, nov. var. (Pl. VI. fig. 17.) Var. lobo polari paullo longiore et incisurâ medianâ profundiore et angustiore; membranâ granulis irregulariter ornatâ.

Long. 54 μ; lat. 33 μ; lat. lob. pol. 16–17 μ; lat. isthm. 11 μ.

No. 0.

48. EUASTRUM SUBROSTRATUM, nov. sp. (Pl. VI. fig. 6.) *E.* subparvum, circiter $1\frac{1}{5}$-plo longius quam latum, profunde constrictum, sinu lineari; semicellulæ trilobæ; lobis lateralibus rotundatis, granulis acutis paucis 3 in ambitu et 3–4 intra marginem; lobo polari latissimo rectangulari, angulis superioribus subrostratis, apicibus subrectis incisurâ medianâ profundâ apertâ, granulis binis intra marginem lateralem utrobique; in centro tumore parvo; a vertice visæ oblongæ, polis rotundatis granulis acutis ornatis, in medio utrobique verrucâ magnâ emarginatâ instructæ.

Long. 38·5 μ; lat. 32·5 μ; lat. lob. pol. 20 μ; lat. isthm. 9 μ; crass. 19 μ.

No. 0.

49. EUASTRUM ELEGANS, Kütz. Phycolog. Germ. p. 135; Ralfs, Brit. Desm. p. 89, tab. xiv. fig. 7. (*Cosmarium elegans*, Bréb. in Menegh. Synop. Desm. p. 222.)

Var. MADAGASCARIENSE, nov. var. (Pl. VI. fig. 18.) Var. semicellulis in partibus superioribus latioribus, apicibus multo convexioribus, in centro triangulo granulorum 3; a vertice et a latere visæ projectione medianâ prominente truncatâ.

Long. 29–37 μ; lat. 19–21 μ; lat. isthm. 4·5–6 μ; crass. 15 μ.

Nos. 0 and 1.

50. EUASTRUM PERSONATUM, nov. sp. (Pl. VI. fig. 19.) *E.* submediocre, pæne $1\frac{1}{2}$-plo longius quam latum, in medio profundissime constrictum, sinu angusto-lineari extremo ampliato; semicellulæ subpyramidato-truncatæ, subtrilobæ, incisuris lateralibus apertis obtusisque; lobis lateralibus retusis, angulis inferioribus rotundatis, angulis superioribus minoribus submamillatis; lobo polari late rectangulari, lateralibus rotundo-convexis, angulis superioribus in spinam brevem validam productis, apice incisurâ medianâ altâ angustâ; semicellulæ supra isthmum tumore, in medio scrobiculis binis horizontaliter ordinatis, intra angulos inferiores granulis tribus et intra angulos superiores granulo singulo præditæ, intra latera lobi polaris cum papillâ; a vertice visæ ellipticæ, tumore mediano; a latere visæ ovatæ, tumore prope basin utrobique, papillâ apicem versus utrobique, apice apiculatis.

Long. 36–39 μ ; lat. 26·5–28 μ; lat. lob. pol. 16·5–17·5 μ; lat. isthm. 6 μ; crass. 16 μ.
No. 3.

51. Euastrum pyramidatum, West, Freshw. Alg. of W. Ireland, p. 139, pl. xx. fig 13.

Var. incrassatum, nov. var. (Pl. VI. fig. 20.) Var. paullo major, semicellulis in medio incrassatis.

Long. 32 μ; lat. 20 μ; lat. isthm. 6 μ; crass. 13·5 μ.

No. 0.

Compare with *Cosmarium sublobatum*, Arch., var. *crispulum*, Nordst. (Bidrag till kännedom sydlig. Norges Desmid. p. 10, fig. 9).

52. Euastrum binale, Ralfs, Brit. Desmid. p. 90, tab. 14. fig. 8.
Long. 17 μ; lat. 15 μ; lat. isthm. 4·5 μ; crass. 8·5 μ. (Pl. IX. fig. 14.)
No. 0.

53. Euastrum denticulatum, F. Gay, Sur les Conj. du Midi de la France, 1884, p. 335.
Long. 16–28 μ; lat. 12–20 μ; lat. isthm. 3–5·5 μ; crass. 13 μ. (Pl. IX. figs. 15, 16.)
Nos. 0 and 1.

Var. rectangulare, nov. var. (Pl. VI. fig. 21.) Var. apicibus et basibus semicellularum æquilatis, granulis paucioribus, tumore centrali sine granulis.

Long. 22 μ; lat. ad bas. semicell. 17·5 μ; lat. ad apic. 17 μ; lat. isthm. 5·5 μ; crass. 10 μ.

No. 3.

54. Euastrum trigibberum, nov. sp. (Pl. VI. fig. 22.) *E.* parvum, paullo longius quam latum, in medio profunde constrictum, sinu lineari; semicellulæ truncato-pyramidatæ, trilobæ, incisuris lateralibus apertis et subprofundis; lobis lateralibus subquadratis in margine 4-granulatis; lobo polari latissime subrectangulari, lateribus bigranulatis, angulis superioribus in spinam productis, apice 4-granulatis incisurâ medianâ altâ; semicellulæ tumore mediano granulis quinque ornato, tumore utrobique granulis quatuor ornato, seriebus duabus horizontalibus granulorum quatuor intra lobum polarem; a vertice visæ ellipticæ, tumore magno utrobique medio trigranulato ad apicem truncatum, prope polos utrobique tumore emarginato, polis trigranulatis; a latere visæ trilobæ, lobis lateralibus apice truncato trigranulato, lobo polari lateribus bigranulatis apice spinâ ornato.

Long. 23 μ; lat. 19·5 μ; lat. lob. pol. 14 μ; lat. isthm. 6·5 μ; crass. 13·5 μ.

No. 18.

The nearest species to this is *E. denticulatum*, F. Gay, from which it differs in the deep lateral incisions of the front view, in the three basal tumours well seen in the vertical view, as well as in other characters.

55. EUASTRUM COSMARIOIDES, nov. sp. (Pl. VI. fig. 23.) *E.* parvum, circiter $1\frac{1}{4}$-plo longius quam latum, profunde constrictum, sinu lineari extremo ampliato; semicellulæ truncato-pyramidatæ, angulis inferioribus late rotundatis, lateribus sub apicibus retusis, apicibus convexis in medio late emarginatis, angulis superioribus subobtusis; a vertice visæ subrhomboideæ, angulis latissime rotundatis, lateribus subretusis; a latere visæ subglobosæ; membranâ glabrâ.

Long. 25–27 μ; lat. 18·5–19 μ; lat. isthm. 4·5–6 μ; crass. 12·5 μ.

No. 0.

This differs from *Cosmarium sublobatum*, Archer, in having the basal angles more widely rounded, in the much sharper superior angles, in the convex emarginate apex (not retuse), and in the different vertical and lateral views.

Genus COSMARIUM, Corda; Ralfs.

56. COSMARIUM SUBMAMILLATUM, nov. sp. (Pl. VI. fig. 34.) *C.* submediocre, $1\frac{1}{4}$-plo longius quam latum, profunde constrictum, sinu lineari extremo ampliato; semicellulæ truncato-pyramidatæ, angulis inferioribus late rotundatis, lateribus concavis infra angulos superiores submamillatos, apicibus truncatis (inter mamillas); a vertice visæ rhomboideo-ellipticæ, mamillis binis intra marginem lateralem utrumque; a latere visæ ovato-truncatæ, infra angulos superiores submamillatos leviter concavæ; membranâ delicatissime punctatâ.

Long. 33–36 μ; lat. 26–29 μ; lat. isthm. 5·5–6·5 μ.

No. 3.

The four submamillate projections at each apex (two of which are only seen in front view) characterize this species.

57. COSMARIUM GRANATUM, Bréb. Liste, p. 26; Ralfs, Brit. Desmid. p. 96, tab. 32. fig. 6.

Long. 32–42 μ; lat. 22–27 μ; lat. isthm. 6–8·5 μ.

Nos. 0 and 1.

Forms of this species were seen agreeing with figs 2, 3, and 7 of Borge (Algologiska Notisa, Bot. Not. 1892, tafl. i.).

Var. SUBANGULARE, nov. var. (Pl. VIII. fig. 4.) Var. minor, $1\frac{1}{4}$-plo longior quam lata, semicellulis angularioribus, lateribus prope basin divergentibus, lateribus superioribus levissime concavis, apicibus leviter retusis.

Long. 23 μ; lat. 18 μ; lat. isthm. 3 μ; crass. 9·5 μ.

No. 0.

This variety approaches f. *alata*, Jacobs., but has the basal angles truncate and not emarginate; the apex is also somewhat retuse.

58. COSMARIUM INÆQUALIPELLICUM, nov. sp. (Pl. VI. figs. 28, 29.) *C.* parvum circiter $1\frac{1}{3}$-plo longius quam latius, profunde constrictum, sinu angusto-lineari extremo

ampliato; semicellulæ truncato-pyramidatæ, angulis inferioribus late rotundatis levissime triundulatis (vel angularibus parte infimâ subdivergentibus) et incrassatis lateribus apicem versus valde retusis, apicibus truncatis levissime triundulatis, angulis superioribus incrassatis subrotundatis; a vertice visæ ellipticæ, polis angularibus angulis tribus obtusis, medio utrobique subinflatæ; a latere visæ truncato-ovatæ, angulis superioribus et inferioribus incrassatis; membranâ minute punctatâ; pyrenoidibus singulis.

Long. 25–33 μ; lat. 20–25 μ; lat. isthm. 5–7·6; crass. 11–13·5 μ.

Nos. 0, 1, and 10.

This species was seen in abundance, and is nearest to *Cosmarium trilobulatum*, Reinsch (Algenfl. mittler. Theil. von Franken, p. 116, taf. ix. fig. vi.), from which it differs in its subundulate and incrassated sides and apex, in its punctate membrane, and in the subtumid and angular vertical view, as well as in its semicells being distinctly less trilobed. Compare also with *C. eductum*, Roy et Biss. in Nordst. Desmidieer från Bornholm, p. 198, tab. vi. fig. 8.

Forma MINOR. (Pl. VI. fig. 30.)

Long. 21 μ; lat. 15 μ; lat. isthm. 4·5 μ; crass. 9·5 μ.

No. 1.

59. COSMARIUM SUBAURICULATUM, nov. sp. (Pl. VI. fig. 31.) *C.* mediocre, tam longum quam latum, modice constrictum, sinu aperto ad extremum subampliato; semicellulæ subellipticæ, dorso convexiore, supra latus unumquodque spinis tribus brevibus obsessæ; a vertice visæ late ellipticæ, ad polum unumquemque cum spinâ singulâ brevi ornatæ; a latere visæ depresso-sphæricæ; membranâ irregulariter punctatâ; pyrenoidibus binis.

Long. 43-46 μ; lat. sine spin. 43–44 μ; lat. cum spin. 44–48 μ; lat. isthm. 21–25 μ; crass. 28 μ.

No. 1.

This is near *C. auriculatum*, Reinsch (Contrib. Alg. et Fung. t. xiv. fig. 5), but the sides are not produced into a tridentate process, the sinus is open, the membrane is not granulate, and the vertical view is broader and not produced at the poles. Compare also with *C. erosum*, Delp., and *C. laticollum*, Delp.

60. COSMARIUM LUNDELLII, Delp. Specim. Desm. Subalp. p. 109, t. 70. fig. 62–64.

Var. MADAGASCARIENSE, nov. var. (Pl. VIII. fig. 2.) Var. septimâ parte longior quam lata, semicellulis in centro non incrassatis, a vertice visis ellipticis, polis latissime rotundatis.

Long. 81 μ; lat. 70 μ; lat. isthm. 33 μ; crass. 43 μ.

Nos. 0 and 18.

Var. SUBANGULARE, nov. var. (Pl. VIII. fig. 3.) Var. major, octavâ parte longior quam lata, angulis inferioribus minus rotundatis, prope angulos inferiores levissime retusis, apicibus subtruncatis, isthmo latiore.

Long. 92 μ; lat. 81 μ; lat. isthm. 51 μ.

No. 0.

61. COSMARIUM PSEUDOPYRAMIDATUM, Lund. Desm. Suec. p. 41, tab. ii. fig. 18.

Long. 54 μ; lat. 31 μ; lat. isthm. 13·5 μ.

No. 0.

62. COSMARIUM ELLIPSOIDEUM, Elfv. Anteckningar om Finska Desmidiéer, p. 13, tab. i. fig. 10.

Forma MINOR, Anders. Bidrag till kännedom Sverig. Chlor. p. 16, fig. 9; *non* Racib. Nonn. Desmid. Polon. p. 28, tab. x. fig. 9.

Long. 23 μ; lat. 19 μ; lat. isthm. 6 μ; crass. 11 μ. (Pl. IX. fig. 25.)

No. 1.

63. COSMARIUM BIREME, Nordst. Desm. Brasil. tab. iii. fig. 33.

Var. ROTUNDATUM, nov. var. (Pl. VI. fig. 37.) Var. paullo longior, lateribus rotundatis, papillâ centrali angustiore.

Long. 15–15·5 μ; lat. 12·5 μ; lat. isthm. 3·5 μ; crass. cum papill. 11·5–12·5 μ.

No. 0.

One example of this variety was seen which had a second papilla on one side of the apex of one semicell.

Var. CRASSUM, nov. var. (Pl. VI. fig. 36.) Var. paullo major, papillâ centrali multo crassiori, membranâ punctatâ.

Long. 18 μ; lat. 16 μ; lat. isthm. 4·5 μ; crass. 15 μ.

No. 0.

64. COSMARIUM TITHOPHORUM, Nordst. De Alg. et Char. i. p. 6, tab. xvi. fig. 6. Forma apicibus leviter depressis.

Long. 19 μ; lat. 20 μ; lat. isthm. 8 μ; crass. 14·5 μ. (Pl. IX. fig. 26.)

No. 1.

65. COSMARIUM PSEUDOPROTUBERANS, Kirchn. Alg. Schles. p. 150; Nordst. Desmid. Nordensk. expedit. till Grönland, tafl. vii. fig. 3.

Var. ANGUSTIUS, Nordst. Freshw. Algæ of New Zeal. & Austr. p. 58, tab. vi. figs. 15, 16. Forma paullo minor. (Pl. IX. fig. 22.)

Long. 23–25 μ; lat. 16–17 μ; lat. isthm. 5 μ; crass. 11·5 μ.

Nos. 3 and 22.

66. Cosmarium subprotuberans, nov. sp. (Pl. VI. fig. 40.) *C.* parvum, paullo longius quam latum, profunde constrictum, sinu lineari in extremo ampliato; semicellulæ irregulariter subpentagonales, lateribus brevibus divergentibus, angulis lateralibus levissime rotundatis, apicibus conico-convexis; a vertice visæ ellipticæ, in medio utrobique magis inflatæ; a latere visæ depresso-ellipticæ; membranâ irregulariter punctatâ; pyrenoidibus singulis.

Long. 19–21 μ; lat. 18 μ; lat. isthm. 4·8 μ; crass. 13·5 μ.

No. 1.

This species comes near to *C. protuberans*, Lund. (Desm. Suec. p. 37, tab. iii. fig. 17), but differs in front view in the conico-convex apex and more acute angles, in vertical view in its broader inflation, and also in the very different form of the lateral view. From *C. pseudoprotuberans*, Kirchn., it differs in its apex and lateral angles, its more inflated vertical view, as well as in its much wider lateral view.

67. Cosmarium quadrogranulatum, nov. sp. (Pl. VI. fig. 38.) *C.* parvum, $1\frac{1}{4}$-plo longius quam latum, profundissime constrictum, sinu angusto-lineari in extremo ampliato; semicellulæ hexagono-hemisphæricæ, angulis lateralibus utrobique granulo singulo instructis, apicibus subrectis; a vertice visæ ellipticæ, granulo ad polum unumquemque sito; a latere visæ subsphæricæ; membranâ glabrâ; pyrenoidibus singulis.

Long. 16·5 μ; lat. 13·5 μ; lat. isthm. 2·2 μ; crass. 8 μ.

No. 1.

The nearest species to this is *C. pseudoprotuberans*, Kirchn., from which it differs in its more rounded semicells, its narrower and deeper constriction, and in the presence of a granule on each of the four lateral angles. *C. pseudoprotuberans*, Kirchn., forma "angulis superioribus semicellularum rotundatis," Borge (Chlorophylloph. från Norska Finmarken, p. 12, tafl. i. fig. 10), is similar in form, but has the sides more divergent, is not so deeply constricted, and has no granules.

68. Cosmarium mamilliferum, Nordst. Desm. Brasil. t. iii. fig. 22.

Var. madagascariense, nov. var. (Pl. VI. fig. 35.) Var. major, pæne tam latum quam longum, semicellulis depressis angulis rotundatis et leviter incrassatis, mamillis majoribus, isthmo angustiore; membranâ minute punctatâ.

Long. 30·5 μ; lat. 26·5 μ; lat. isthm. 5·5 μ; crass. sine nod. 16 μ.

No. 3.

69. Cosmarium sulcatum, Nordst. De Algis et Characeis Sandwicensibus, p. 13, tab. i. figs. 18–20.

Long. 35–38·5 μ; lat. 31–34·5 μ; lat. isthm. 9·5–10·5 μ; crass. 18 μ. (Pl. V. figs. 28, 29.)

No. 0.

70. Cosmarium Regnellii, Wille, Bidrag til Sydam. Algfl. p. 16, t. i. fig. 34.

Var. madagascariense, nov. var. (Pl. VI. fig. 39.) Var. angulis inferioribus minus rectangularibus, sed lateribus plus divergentibus, sub apicibus levissime retusis, apicibus levissime retusis vel rectis.

Long. 14–15 μ; lat. 14–17 μ; lat. isthm. 3·5–4 μ; crass. 6–7·5 μ.

No. 3.

The forms of this variety seem to connect the species to *C. capitulum*, Roy et Biss. (Jap. Desm. in Journ. Bot. 1886, vol. xxv. p. 195, t. 268. f. 9).

71. Cosmarium geometricum, nov. sp. (Pl. VI. fig. 32.) *C.* minutissimum, tam longum quam latum, profundissime constrictum, sinu lineari extrorsum ampliato; semicellulæ latissime truncato-pyramidatæ, lateribus rectis et apicibus concavis, angulis inferioribus acutis, angulis superioribus subapiculatis, in centro papillâ præditæ; a vertice visæ ellipticæ, ad polos subapiculatæ, papillâ medianâ utrobique instructæ; a latere visæ globosæ, in medio utrobique papillâ præditæ; pyrenoidibus singulis.

Long. 9·5–10·5 μ; lat. 9·5–10·5 μ; lat. isthm. 2 μ; crass. 6 μ.

No. 3.

72. Cosmarium Sinostegos, Schaar. Magyar. Desmid. p. 266, fig. 12.

Var. obtusius, Gutw. Materyaly do Flory Glonów Galicyi, p. 26, tab. iii. fig. 13; Diagnos. nonnull. algar. nov. Galicia in Nuova Notarisia, Apr. 5, 1892, p. 21. Forma minor, semicellulæ a vertice visæ acutius quam in formâ typicâ papillatæ.

Long. 9–10·8 μ; lat. 11–11·5 μ; lat. isthm. 3·6 μ; crass. 7·2 μ. (Pl. VI. fig. 33.)

No. 1.

73. Cosmarium emarginatum, nov. sp. (Pl. VIII. fig. 14.) *C.* minutissimum, paullo longius quam latum, modice constrictum, sinu aperto subrectangulari obtuso; semicellulæ subellipticæ, ventre leviter convexæ, dorso valde convexæ et in medio retusæ; a vertice visæ ellipticæ, medio utrobique leviter subtumidæ; a latere visæ subglobosæ; membranâ glabrâ.

Long. 8–9·5 μ; lat. 7–8 μ; lat. isthm. 4·4–4·8 μ; crass. 7·6–8·5 μ.

Nos. 0 and 1.

74. Cosmarium minimum, nov. sp. (Pl. VIII. fig. 10.) *C.* minutissimum, quadratum, paullo longius quam latum, modice constrictum, sinu sublineari; semicellulæ transversim rectangulares, lateribus et apicibus subrectis, angulis levissime rotundatis; a vertice visæ ellipticæ; a latere visæ subrotundatæ, apice truncato; membranâ glabrâ; pyrenoidibus singulis.

Long. 8·4 μ; lat. 7·2 μ; lat. isthm. 3 μ; crass. 4·7 μ.

No. 1.

This is one of the least *Cosmaria* yet described, and has a characteristic form.

Var. SUBROTUNDATUM, nov. var. (Pl. VIII. fig. 11.) Var. paullo longior quam forma typica, lateribus leviter convexis et apicibus rectis vel levissime concavis.

Long. 8–9 μ; lat. 6·7–7 μ; lat. isthm. 2–2·5 μ; crass. 4·5 μ.

No. 1.

75. COSMARIUM MENEGHINII, Bréb. in Ralfs, Brit. Desmid. p. 96, tab. xv. fig. 6.

Long. 16–20 μ; lat. 12·5–14·5 μ; lat. isthm. 2·5 μ; crass. 7–7·5 μ. (Pl. VI. fig. 41.)

Nos. 1 and 10.

These forms agree with *C. Braunii*, Reinsch, v. *Meneghinii*, Reinsch (Algenfl. mittl. Theil. von Frank. p. 115, taf. x. fig. iii. *d*).

76. COSMARIUM CONCINNUM, Reinsch, Algenfl. mittl. Theil. von Frank. p. 110, taf. ix. fig. iii. (*C. Meneghinii*, Bréb., var. *concinnum*, Rabenh. Fl. Europ. Alg. iii. p. 163.)

Long. 12·5–13·5 μ; lat. 9·5–10 μ; lat. isthm. 2 μ; crass. 5·3–6 μ. (Pl. IX. fig. 23.)

Nos. 0 and 1.

77. COSMARIUM LÆVE, Rabenh. Fl. Europ. Alg. iii. p. 161; Nordst. in Wittr. et Nordst. Desm. et Œdog. in Ital. et Tyrol. p. 29, t. xii. fig. 4. Forma membranâ glabrâ. (Cfr. Racib. Desmid. w pod. naokol. ziem. p. 4, t. vi. figs. 19, 20.)

Long. 16 μ; lat. 12·5 μ; lat. isthm. 2 μ; crass. 6·5 μ.

No. 3.

78. COSMARIUM PLANUM, nov. sp. (Pl. VIII. fig. 9.) *C.* parvum, pæne duplo longius quam latum, profunde constrictum, sinu subaperto et acuto; semicellulæ truncato-pyramidatæ, angulis inferioribus valde rotundatis, angulis superioribus rotundatis, apicibus subretusis; a vertice et a latere visæ ellipticæ; membranâ glabrâ; pyrenoidibus singulis.

Long. 29–35 μ; lat. 17–18 μ; lat. isthm. 5·8–7 μ; crass. 11–5 μ.

No. 0.

This species may be compared with some forms of *C. Meneghinii*, Bréb., and *C. læve*, Rabenh.

79. COSMARIUM REGNESII, Reinsch, Algenfl. mittl. Theil. von Frank. p. 112, taf. vii. fig. viii.

Var. TRITUM, West, Freshw. Alg. of W. Ireland, p. 149, pl. xxi. fig. 3.

Long. 8·5 μ; lat. 8·5 μ; lat. isthm. 5 μ; crass. 4 μ. (Pl. IX. fig. 24.)

No. 3.

80. COSMARIUM PSEUDOREGNESII, nov. sp. (Pl. VI. figs. 42, 43.) *C.* minutum, paullo longius quam latum, profunde constrictum, sinu excavato et semielliptico; semicellulæ subrectangulares, angulis inferioribus acutis, angulis superioribus emarginatis, lateribus retusis, apicibus biundulatis (retusis in medio), in centro

umbonatæ, intra marginem anguli superioris emarginati uniuscujusque papillâ instructæ; a vertice visæ ellipticæ, in medio umbone et polos triangulatos versus papillâ utrobique instructæ; a latere visæ subsphæricæ in medio umbonato utrobique, apicibus papillis tribus instructæ.

Long. 14–15·5 μ; lat. 13·5 μ; lat. isthm. 5–5·2 μ; crass. 5·5–7·7 μ.

No. 0. (See note on p. 90.)

This approaches *C. Regnesii*, Reinsch, but is larger and a little longer in proportion to its breadth; the isthmus is also comparatively narrower, but the lateral and vertical views, with their protuberances, are markedly characteristic. This was seen in fair abundance from Riccall Common, E. Yorks., but the protuberances in the vertical view were less marked than in the examples from Madagascar. Fig. 43 is from a Riccall specimen. *C. Regnesii*, Reinsch, is also figured for comparison (Pl. VI. fig. 44).

81. Cosmarium sublatere-undatum, nov. sp. (Pl. VI. fig. 1.) *C.* submediocre, paullo longius quam latius, rotundo-hexagonum, profunde constrictum, sinu angusto-lineari extremo subampliato; semicellulæ late truncato-pyramidatæ, lateribus convexis 6-undulatis, apicibus truncatis et levissime 2-undulatis; a vertice visæ ellipticæ polis leviter undulatis; a latere visæ circulares; membranâ irregulariter punctatâ.

Long. 38·5–40 μ; lat. 34·5–38·5 μ; lat. apic. 19–21 μ; lat. isthm. 11·5–15; crass. 19 μ.

No. 0.

This is nearest to *C. latere-undatum*, Roy (in litt. cum icone) (see note on p. 90), but differs in its larger size, its relatively broader cells, in the sides having more undulations, in the faintly undulate apex, and in its punctate membrane; in the lateral view it is also more spherical, and the poles of the vertical view are slightly undulate. Compare also with *C. cyclicum*, Lund., var. *angulatum*, West (Freshw. Alg. of N. Yorks. in Journ. Bot., Oct. 1889, tab. 291. fig. 2; Freshw. Alg. of Eng. Lake District in Journ. Roy. Micr. Soc., Dec. 1892, p. 728, pl. ix. fig. 19).

82. Cosmarium beatum, nov. sp. (Pl. VII. fig. 8.) *C.* parvum, paullo longius quam latum, profunde constrictum, sinu aperto extremum versus lineari extremo subampliato; semicellulæ late truncato-pyramidatæ, angulis inferioribus rotundatis, granulis acutis tribus, lateribus verrucis emarginatis duabus, apicibus truncatis granulis 5–6 præditis, in centro cum granulo magno et semicirculo granulorum 5 circa et subter illud; a vertice visæ elliptico-angulares, medio utrinque granulis tribus ornatæ, intra marginem lateralem utrumque serie granulorum polis truncatis tenus, polis granulis tribus præditis; a latere visæ hexagono-circulares, apicibus subtruncatis, angulis superioribus cum papillâ parvâ, utrinque granulis binis instructis.

Long. 31·5 μ; lat. 27 μ; lat. isthm. 8 μ; crass. 19 μ.

No. 3.

This species and the two following are evidently allies of *C. monomazum*, Lund.

83. Cosmarium bellum, nov. sp. (Pl. VII. fig. 9.) *C.* parvum, paullo longius quam latum, modice constrictum, sinu lineari extremo subampliato; semicellulæ late truncato-

pyramidatæ, lateribus verrucis tribus præditis, superioribus duabus subemarginatis, infimâ rotundato-truncato, apicibus truncatis verrucis truncatis 6 ornatis, in medio ad basin cum verrucis tribus in serie transversâ (maxima in medio); a vertice visæ elliptico-angulares ad polos truncato-retusæ, medio utrobique verrucis tribus instructæ, maximâ emarginatâ ad medium protuberatâ, intra marginem lateralem utrumque serie verrucarum angularium; a latere visæ truncato-pyramidatæ, angulis inferioribus subproductis, lateribus levissime undulatis, angulis superioribus papillâ parvâ instructis; membranâ delicatissime punctatâ.

Long. 28 μ; lat. 26·5 μ; lat. isthm. 11 μ; crass. 22 μ.

No. 3.

84. Cosmarium eximium, nov. sp. (Pl. VII. fig. 10.) *C.* parvum, tam longum quam latum, profunde constrictum, sinu lineari extremo leviter ampliato; semicellulæ late truncato-pyramidatæ, angulis inferioribus subrotundatis, lateribus et apicibus verrucis emarginatis (in ambitu circiter 16) ornatæ, serie granulorum intra marginem, in centro cum annulo granulorum 6 circa granulum majus centrale; a vertice visæ rhomboideo-ellipticæ, polis truncatis, seriebus parallelis duabus verrucarum emarginatarum de polo ad polum, etiam serie granulorum parvorum intra marginem lateralem utrumque, medio utrobique granulis tribus instructæ; a latere visæ pyramidatæ, angulis inferioribus rotundatis et trigranulatis, apicibus truncatis, angulis superioribus papillâ minute præditis; membranâ subtilissime punctatâ.

Long. 28 μ; lat. 29 μ; lat. isthm. 9·5 μ; crass. 17 μ.

No. 36.

85. Cosmarium decoratum, nov. sp. (Pl. VII. fig. 21.) *C.* submagnum, circiter 1⅓-plo longius quam latius, profunde constrictum, sinu lineari extremo subampliato; semicellulæ truncato-pyramidatæ, angulis inferioribus et superioribus rotundatis, lateribus convexis, apicibus subrectis subconvexisve; membrana depressionibus formarum duarum quincuncialiter ordinatis ornata, inter 2 depressiones rotundatis binis depressionibus triangularibus, circa unamquamque depressionem rotundatam depressionibus triangularibus 6; a vertice visæ ellipticæ, in medio utrobique late tumidæ; a latere visæ late ovatæ; massa chlorophyllacea semicellularum laminis lateralibus quaternis.

Long. 70–86 μ; lat. 52–63 μ; lat. isthm. 23–32·5 μ; crass. 32·5–40 μ.

Nos. 0 and 1.

In this species the granular appearance is produced by depressions arranged in the same manner as those on *C. glyptodermum* (n. 111), but in this case they are of two forms.

86. Cosmarium Baronii, nov. sp. (Pl. VII. fig. 30.) *C.* permagnum, prope 1½-plo longius quam latum, profunde constrictum, sinu lineari; semicellulæ granulatæ, pyramidato-truncatæ, angulis inferioribus et superioribus rotundatis, lateribus subrectis vel

subconcavis, apicibus truncatis vel levissime convexis; granulis magnis in seriebus concentricis marginem versus, minoribus et irregulariter medium versus ordinatis, infra centrum seriebus 3–4 granulis majoribus (6–8 in serie unâquaque) cum hexagono scrobiculorum parvorum circa granulum majorem unumquemque; a vertice visæ rhomboideo-ellipticæ, granulis subconcentrice ordinatis, in centro granulis sparsissimis irregulariter dispersis, ad medium utrobique granulis 6–8 multo majoribus; membranâ inter granulos irregulariter punctatâ.

Long. 142–161 μ; lat. 111–119 μ; lat. isthm. 32–38 μ; lat. apic. circ. 43–45 μ; crass. 72 μ.

No. 0.

This is one of the largest and most beautiful species yet described, the only one at all approaching it being *Cosmarium magnificum*, Nordst. (Freshw. Alg. of New Zeal. & Austr. p. 62, tab. 6. fig. 19), from which it is quite distinct.

The hexagons of scrobiculations round the larger central warts were arranged in such a manner that two opposite angles were always on a vertical line. This was the case in all the specimens examined, and the hexagons appeared to gradually fade off amongst the granules outside them, the latter being irregular and finally becoming larger and concentrically disposed.

87. Cosmarium Anax, nov. sp. (Pl. VII. fig. 7.) *C.* permagnum, paullo longius quam latum, profunde constrictum, sinu lineari extrorsum ampliato; semicellulæ late pyramidatæ, angulis inferioribus latissime rotundatis, lateribus subconcavis, angulis superioribus rotundatis, apicibus anguste truncatis subrectis vel levissime concavis et in medio incrassatis; membranâ scrobiculatâ et minutissime punctatâ inter scrobiculos, in centro sine scrobiculis, sed minutissime punctatâ; a vertice visæ ellipticæ, polis porrectis et late rotundatis.

Long. 173 μ; lat. 153 μ; lat. apic. 42 μ; lat. isthm. 52 μ; crass. 86 μ.

No. 0.

This is also one of the largest and most characteristic species of the genus. A portion of the membrane is figured under a higher magnification to show the scrobiculations with the intervening punctulations (fig. 7, *e*).

88. Cosmarium Pseudobroomei, Wolle, Desm. U.S. of America, p. 86, pl. 51. figs. 36, 37; Turner, Freshw. Alg. of E. India, p. 66, tab. ix. fig. 41.

Var. madagascariense, nov. var. (Pl. VII. fig. 34.) Var. major, semicellularum lateribus subdivergentibus vel parallelis; granulis ad medium multo minoribus.

Long. 49–51 μ; lat. 44–49 μ; lat. isthm. 12·5–16·5 μ; crass. 25 μ.

No. 3.

Var. elegans, nov. var. (Pl. VI. fig. 25.) Var. cellulis granulis paucioribus majoribusque; a vertice visis crassioribus.

Long. 42 μ; lat. 33·5 μ; lat. isthm. 11·5 μ; crass. 20 μ.

No. 0.

89. Cosmarium creperum, nov. sp. (Pl. VII. fig. 11.) C. parvum, paullo longius quam latum, profunde constrictum, sinu oblongo-lineari aperto; semicellulæ transverse oblongæ, lateribus rotundatis, apicibus truncatis; a vertice visæ oblongæ, polis rotundatis; a latere visæ circulares; membranâ granulatâ, granulis distantibus quincuncialiter ordinatis; pyrenoidibus binis.

Long. 30 μ; lat. 27 μ; lat. isthm. 9·5 μ; crass. 14 μ.

No. 3.

Compare with *C. Pseudobroomei*, Wolle.

Var. compressum, nov. var. (Pl. VII. fig. 33.) Var. semicellulis plus depressis, granulis minoribus et numerosioribus subirregulariter ordinatis; zygosporâ subrhomboideo-ellipticâ, membranâ glabrâ.

Long. 22 μ; lat. 23 μ; lat. isthm. 7·7 μ; crass. 11·5 μ; long. zygosp. 33 μ; lat. zygosp. 27 μ.

No. 1.

90. Cosmarium isthmochondrum, Nordst. Bidrag till känn. sydlig. Norges Desm. p. 35, tab. i. fig. 17.

Var. biseriatum, nov. var. (Pl. VII. fig. 14.) Var. paullo minor, isthmo angustiore, semicellulis apice granulatis, intra marginem granulis (nec scrobiculis) 4 præditis et ad isthmum granulis binis minoribus.

Long. 23 μ; lat. 20 μ; lat. isthm. 5·7 μ; crass. 13 μ.

No. 3.

91. Cosmarium subalatum, nov. sp. (Pl. VII. fig. 31.) C. parvum, sextâ parte longius quam latum, profunde constrictum, sinu angusto-lineari extremo ampliato; semicellulæ late truncato-pyramidatæ, angulis inferioribus rotundatis, lateribus 2-crenatis, apicibus 4-crenatis (crenis minoribus quam eæ in lateribus); crenâ infimâ granulis tribus ad marginem, reliquis in ambitu toto granulis duobus ad marginem, seriebus radiantibus granulorum 2 vel 3 intra marginem; in centro tumore parvo granulato; a vertice visæ ellipticæ, ad medium utrobique subtumidæ, granulis in seriebus 10 transversis ordinatis; a latere visæ anguste truncato-pyramidatæ, angulis inferioribus et superioribus rotundatis, granulis in seriebus transversis 7 ordinatis.

Long. 21 μ; lat. 17 μ; lat. isthm. 3·8 μ; crass. 10·5 μ.

Nos. 0 and 1.

Compare with *C. alatum*, Kirchn. (Alg. Schles. p. 153).

92. Cosmarium punctulatum, Bréb. List Desm. p. 129, tab. i. fig. 15; De Notaris, Element. per lo stud. delle Desmid. Ital. p. 46, t. iv. fig. 33.

Var. ornatum, Istv. Diag. Algar. Nov., Notarisia, 1887, p. 8.

Long. 21 μ; lat. 16 μ; lat. isthm. 5·5 μ; crass. 10·5 μ. (Pl. VII. fig. 28.)

No. 0.

93. Cosmarium pulvinatum, nov. sp. (Pl. VI. fig. 24.) *C.* parvum, paullo latius quam longum, profunde constrictum, sinu lineari extremo subampliato; semicellulæ oblongo-ellipticæ, apicibus truncatis subtruncatisve; a vertice visæ angusto-ellipticæ, in medio utrobique multo inflatæ; a latere visæ depresso-ellipticæ, apicibus subtruncatis; membranâ minute et irregulariter granulatâ.

Long. 17–18·5 μ; lat. 21·5–22·5 μ; lat. isthm. 7–7·8 μ; crass. 14 μ.

No. 36.

This species differs from *C. punctulatum*, Bréb., in its depressed cells, smaller granules, and in the large inflation on each side of the semicells, as seen in vertical view.

94. Cosmarium trachydermum, nov. sp. (Pl. VI. fig. 26.) *C.* mediocre, paullo longius quam latum, modice constrictum, sinu aperto extremo obtuso; semicellulæ elliptico-oblongæ, lateribus rotundatis, apicibus subtruncatis; a vertice visæ ellipticæ; a latere visæ subcirculares; membranâ granulatâ, granulis parvis et irregulariter ordinatis; pyrenoidibus binis.

Long. 40·5 μ; lat. 36 μ; lat. isthm. 16 μ; crass. 21 μ.

No. 1.

Compare with *C. scabratulum*, n. sp., and *C. Holmii*, Wille, f. *depauperata*, Boldt. (Desmidieer från Grönland, p. 27, tab. ii. fig. 29).

95. Cosmarium scabratulum, nov. sp. (Pl. VI. fig. 27.) *C.* mediocre, paullo longius quam latum, submodice constrictum, sinu multo aperto extremo obtuso; semicellulæ ellipticæ; a vertice visæ late ellipticæ, ad polum unumquemque leviter productæ; a latere visæ depresso-globosæ; membranâ granulatâ, granulis parvis et irregulariter ordinatis.

Long. 42 μ; lat. 35–38·5 μ; lat. isthm. 16–19 μ; crass. 24–27 μ.

Nos. 0 and 1.

In some specimens the apices and the rounded sides of the vertical view appear to be less granulate than the rest of the membrane. Its nearest ally is *C. trachydermum*, suprà, from which it differs in its elliptical semicells, more open sinus, and different vertical view.

96. Cosmarium Blyttii, Wille, Bidrag til Kundsk. om Norges Ferskv. Alg. p. 25, tab. i. fig. 7.

Long. 15·5 μ; lat. 13 μ; lat. isthm. 4 μ; crass. 8·5 μ.

Nos. 0, 1, and 3.

97. Cosmarium spyridion, nov. sp. (Pl. VIII. fig. 26.) *C.* minutum, paullo latius quam longum, modice constrictum, sinu aperto et obtuso; semicellulæ hexagono-ellipticæ, angulis lateralibus rotundatis granulis parvis tribus præditis, infra apicem utrobique concavis, apicibus truncatis minutissime 4-granulato-undulatis, intra angulos laterales granulis minutis 3–4, in centro papillâ instructis; a vertice visæ ellipticæ, minute

granulatæ, in medio utrobique papillâ instructæ; a latere visæ subrotundæ, papillâ medianâ utrobique instructæ; pyrenoidibus singulis.

Long. 11·5–12·5 μ; lat. max. semicell. 12·5–13·5 μ; lat. ad apic. 7·7–8·5 μ; lat. isthm. 5·5–6·5 μ; crass. 9 μ.

No. 3.

98. Cosmarium abruptum, Lund. Desm. Suec. p. 43, tab. ii. fig. 22.

Var. granulatum, nov. var. (Pl. VII. fig. 32.) Var. cellulis granulis parvis in ambitu toto et intra marginem ornatis.

Long. 14–15 μ; lat. 13·5–14·5 μ; lat. isthm. 4 μ; crass. 8·5 μ.

Nos. 0, 1, 3, and 18.

99. Cosmarium haaboliense, Wille, Bidrag til Kundsk. om Norges Ferskv. Alg. p. 25, tab. i. fig. 6.

Var. protractum, nov. var. (Pl. VII. fig. 13.) Var. semicellulis truncato-pyramidatis, angulis inferioribus rotundatis, sub apicibus leviter retusis, apicibus late truncatis.

Long. 23 μ; lat. 22 μ; lat. apic. 14 μ; lat. isthm. 8 μ; crass. 13 μ.

No. 0.

100. Cosmarium dichondrum, nov. sp. (Pl. VII. fig. 12.) *C.* parvum, paullo longius quam latum, profunde constrictum, sinu lineari extremo subampliato; semicellulæ ellipticæ minute et irregulariter granulatæ, granulis magnis binis in medio intra apicem; a vertice visæ ellipticæ, utrobique granulis magnis binis instructis; a latere visæ circulares, granulo magno utrobique ad apicem.

Long. 21 μ; lat. 19 μ; lat. isthm. 6 μ; crass. 11·5 μ.

No. 18.

Compare with *C. haaboliense*, Wille (*l. c.*), and *C. trigemmatum*, Delp. (Desm. Subalp. p. 109, tab. 7. figs. 59–61).

101. Cosmarium tripapillatum, nov. sp. (Pl. VII. fig. 24.) *C.* minutum, tam longum quam latum, modice constrictum, sinu sublineari; semicellulæ elliptico-oblongæ, apicibus late truncatæ, membranâ minute granulatâ, granulis circiter 5 latere unoquoque, apicibus indistincte granulatis, intra apicem unumquemque serie horizontali granulorum trium majorum; a vertice visæ ellipticæ, in medio utrobique granulis tribus præditæ; a latere visæ subglobosæ, granulo singulo in parte superiore lateris uniuscujusque instructæ.

Long. = lat. = 15·4–17·3 μ; lat. isthm. 6·5–7·5 μ; crass. 9–10·5 μ.

No. 3.

Compare with *C. polymorphum*, Nordst. (Desm. Brasil. tab. iii. fig. 31).

Var. ALASTRENSE, nov. var. (Pl. VII. fig. 25.) Var. minor, granulis majoribus in toto ambitu prædita.

Long.=lat.=13·5 μ; lat. isthm. 4·8 μ; crass. 7·7 μ.

No. 36.

102. COSMARIUM TRIORDINATUM, nov. sp. (Pl. VII. fig. 27.) *C.* parvum, paullo latius quam longum, profunde constrictum, sinu lineari extremo non ampliato; semicellulæ oblongæ, lateribus rotundatis, apicibus subrectis, lateribus granulis acutis 6–7, granulis intra marginem lateralem utrumque subirregulariter ordinatis, granulis ad apicem multo minoribus, in centro seriebus tribus verticalibus granulorum magnorum, quatuor in serie utrâquâque; a vertice visæ ellipticæ, in medio utrobique leviter inflatæ crenis tribus instructæ, ad polos rotundatos granulis acutis (circa 6) et aliis intra marginem subirregulariter dispositis; a latere visæ depresso-globosæ ($1\frac{1}{4}$-plo latius quam longius), lateribus 4-crenatis.

Long. 25–27 μ; lat. 29–31 μ; lat. isthm. 10·5–11·5 μ; crass. 17–18·5 μ.

No. 0.

103. COSMARIUM KIRCHNERI, Boerg. Bidrag til Bornholms Desmidié-Flora, p. 143, tab. vi. fig. 3. (*C. trachypleurum*, Lund., var. *verrucosum*, Kirchn. Alg. Schles. p. 151.)

Var. UNIFORME, nov. var. (Pl. VII. fig. 18.) Var. minor, semicellulis papillis minus numerosis et plus regularibus, papillis in ambitu toto (non reductis ad apicem), in centro verrucis æqualibus 7 (6 periphericis, 1 centrali).

Long. sine pap. 49 μ; lat. sine pap. 41 μ; lat. isthm. 15 μ; crass. 31 μ.

No. 0.

104. COSMARIUM TRACHYPLEURUM, Lund. Desm. Suec. p. 27, tab. ii. fig. 12.

Var. SPINOSUM, nov. var. (Pl. VII. fig. 17.) Var. semicellularum angulis inferioribus minus rotundatis, lateribus spinis brevibus et intra marginem seriebus (circ.) 3 spinarum brevium obsessis, apicibus granulis parvis acutis paucis ornatis; semicellulæ a vertice visæ angustiores.

Long. 42–43 μ; lat. sine spin. brev. 38–38·5 μ; lat. isthm. 12·5–13 μ; crass. 22 μ.

No. 36.

This variety seems to connect *C. trachypleurum*, Lund., and *C. Kirchneri*, Bœrg.

105. COSMARIUM TAXICHONDRUM, Lund., Desm. Suec. p. 39, t. ii. fig. 13.

Long. 39 μ; lat. 32·5 μ; lat. isthm. 9·5 μ; crass. 20 μ. (Pl. VII. fig. 2.)

No. 0.

Var. EMARGINATUM, nov. var. (Pl. VII. fig. 3.) Var. semicellulis supra angulos inferiores biundulatis, in centro granulis in seriebus tribus horizontalibus, 4 in serie

superiore, 3 in serie mediana, 4 in serie inferiore, granulo supra isthmum nullo; a vertice visis polis emarginatis, lateribus medio utrobique granulis tribus, granulis quattuor intra marginem instructis.

Long. 39 μ; lat. 38 μ; lat. isthm. 15 μ; crass. 21 μ.

No. 0.

This variety is very similar to *Cosmarium taxichondrum*, Lund., var. *bidentulum*, Lagerh. (Bidrag till Amerikas Desmidié-Flora, p. 237, tab. xxviii. fig. 8), but has the central granules differently arranged, is without the large sharp granule above the isthmus, and also has two undulations above the subtruncately toothed basal angles.

Var. SUBUNDULATUM, Boldt, Siber. Chlorophylloph. p. 101, taf. v. fig. 4.

Forma SUBDENTICULATUM. (Pl. VII. fig. 4.) Forma lateribus subdenticulatis (non undulatis), granulo supra isthmum nullo; a vertice visa polis triundulatis.

Long. 26–27 μ; lat. 24–25·5 μ; lat. apic. 14·5–16 μ; lat. isthm. 6–7·5 μ; crass. 15 μ.

No. 1.

Var. DENTATUM, nov. var. (Pl. VII. fig. 5.) Var. minor et paullo latior quam longa; semicellulis subangularibus, apicibus late truncatis, angulis superioribus inferioribusque dente instructis, lateribus tridenticulatis, serie dentium 4 intra apicem, serie granulorum 3 in centro, et granulo singulo supra isthmum; a vertice visis polis triangulatis, in medio utrobique triangulatis, intra marginem dentibus 4 præditis; a latere visis subrotundis, apice subtruncato, angulis superioribus unidentatis, lateribus granulis duobus obsessis.

Long. 27 μ; lat. 31·5 μ; lat. apic. 20 μ; lat. isthm. 9·5 μ; crass. 19 μ.

No. 0.

On comparing the var. *dentatum* with the typical *C. taxichondrum* they hardly seem to belong to the same species, but var. *subundulatum*, with its forma *subdenticulatum*, certainly connect the two.

Var. COMPRESSUM, nov. var. (Pl. VII. fig. 6.) Var. $1\frac{1}{3}$-plo latior quam longa, semicellulæ subangulares, apicibus subtruncatis, angulis inferioribus rectangularibus prope basin; in medio seriebus duabus granulorum apicem versus, 2 in serie superiore, 3 in serie inferiore; a vertice visæ angustiores, polis bidentulatis, in medio utrobique granulis tribus et duobus intra marginem instructæ, membranâ dense sed minute punctatâ.

Long. 31 μ; lat. 41 μ; lat. isthm. 14 μ; crass. 18 μ.

No. 0.

106. COSMARIUM NOTOCHONDRUM, nov. sp. (Pl. VII. fig. 1.) *C.* parvum, $1\frac{1}{4}$-plo latius quam longum, profunde constrictum, sinu lineari; semicellulæ rectangulares, angulis inferioribus rectangularibus et apiculatis, angulis superioribus truncatis, in medio latere unoquoque cum apiculo, apicibus levissime concavis, juxta apicem serie

horizontali papillarum 4; a vertice visæ rhomboideo-ellipticæ, polis tridenticulatis juxta marginem lateralem utrumque papillis 4 instructis; a latere visæ depresso-ellipticæ, apicibus subtruncatis, angulis superioribus utrobique papillâ singulâ præditis.

Long. 19 μ; lat. 24 μ; lat. isthm. 6·5 μ; crass. 13·5 μ.

No. 1.

This species comes nearest to *Cosmarium pseudotaxichondrum*, Nordst. (Nonnull. Alg. Brasil. p. 20, tab. ii. fig. 5), but is smaller and proportionately broader at the apex; in front view it has an additional tooth at each side and four granules just within the apex; in vertical view it is more rhomboid, and has the granules more pronounced and *within* the margins; the poles are also trigranulate, and the side view is also very much compressed (not globose), with one papilla on either side of the truncate apex.

107. Cosmarium rostellum, nov. sp. (Pl. VII. fig. 19.) *C.* submediocre, circiter $1\frac{1}{3}$-plo longius quam latum, profunde constrictum, sinu angusto-lineari; semicellulæ truncato-pyramidatæ, angulis inferioribus obtuse apiculatis, lateribus leviter 5–6-undulatis, angulis superioribus subrotundatis, apicibus subrectis, in centro granulis 5 instructis; a vertice visæ ellipticæ, polis subacutis medio utrobique granulis tribus instructis; a latere visæ subrotundatæ, medio utrobique granulis binis instructæ; membrana irregulariter punctata

Long. 46 μ; lat. 36·5 μ; lat. apic. 21 μ; lat. isthm. 11 μ; crass. 20 μ.

No. 0.

Forma minor. (Pl. VII. fig. 20.)

Long. 35 μ; lat. 29 μ; lat. apic. 17 μ; lat. isthm. 9 μ; crass. 13·5 μ.

No. 0.

108. Cosmarium scitum, nov. sp. (Pl. VII. fig. 29.) *C.* parvum, paullo longius quam latum, profunde constrictum, sinu angusto-lineari extremo ampliato; semicellulæ truncato-pyramidatæ, angulis inferioribus subrotundatis trigranulatis, lateribus subrectis subconcavisve, intra apices subconvexos serie granulorum 5–6, granulis paucis sparsis intra ambitum totum, in centro granulis 5 in seriebus duabus (2 infra et 3 supra); a vertice visæ ellipticæ, polis subacutis in medio utrobique granulis tribus instructis, intra marginem lateralem utrumque serie granulorum 5–6, granulis 2–3 utrobique prope polos; a latere visæ subsphæricæ, apicibus truncatis, in ambitu toto granulis distantibus 6 præditæ; pyrenoidibus binis.

Long. 28–32·5 μ; lat. 26–29 μ; lat. isthm. 7·5–8 μ; crass. 14·5–15·5 μ.

Nos. 0 and 1.

This comes nearest to *C. polymorphum*, Nordst.; **paulense*, Bœrg. (Desm. Brasil. p. 943, tab. iv. fig. 28). It differs in its smooth apex and upper part of its sides, the inferior angles alone being trigranulate; the granules in the centre are differently arranged, and the vertical view has subacute poles with only three median granules at

the sides and with no granules within the poles; the side view also has the granules distant from each other.

The stated magnifications of Bœrgesen's figures (*l. c.*) in his descriptions of the plates must certainly be wrong according to his own measurements in the text!

109. Cosmarium elaboratum, nov. sp. (Pl. VII. fig. 15.) *C.* mediocre, $1\frac{1}{4}$-plo longius quam latum, profunde constrictum, sinu angusto-lineari extremo subampliato; semicellulæ subsemicirculares apicibus levissime depressis, angulis inferioribus subrectangularibus, lateribus undulato-crenatis 5–6 majoribus sursum, apicibus verrucis rotundo-quadratis magnis 4, intra apicem serie verrucarum magnarum 5 (vel 6), intra angulos inferiores granulis 1–3, in centro granulis 5–8 varie ordinatis; a vertice visæ ellipticæ, polis truncatis tripapillatis, verrucis magnis 5 (vel 6) utrobique, intra marginem lateralem utrumque serie verrucarum magnarum (circ.) 8, in medio de polo ad polum papillis binis 5 ordinatæ; a latere visæ subcyathiformes, marginibus superioribus verrucis magnis duabus, marginibus inferioribus verrucis minoribus duabus instructis, serie verrucarum magnarum intra marginem verticale lateralem utrumque et in medio serie singulâ verticali granulorum; membranâ delicatissime punctatâ.

Long. 53–54 μ; lat. 40·5–42 μ; lat. isthm. 15·5–17 μ; crass. 28 μ.
No. 0.

110. Cosmarium subspeciosum, Nordst. Desm. Arct. p. 22, tab. vi. fig. 13.

Var. truncatum, nov. var. (Pl. VII. fig. 22.) Var. semicellulis apicibus magis truncatis crenis 5, crenis lateralibus 6, crenis granulatis ut in formâ typicâ, supra isthmum tumore granulato, granulis in seriebus verticalibus 6; a vertice visis tumore majore; a latere visis tumore basali prominentiore, apicibus truncatis.

Long. 42·5 μ; lat. 34 μ; lat. isthm. 15 μ; crass. 20 μ.
No. 0.

Var. effigiatum, nov. var. (Pl. VII. fig. 16.) Var. major, semicellulis crenis lateralibus 8, subemarginatis (non granulatis), supra isthmum tumore granulato, granulis in seriebus verticalibus confertis 7, a vertice et a latere visis tumore majore.

Long. 74 μ; lat. 51 μ; lat. isthm. 17·5 μ; crass. 34 μ.

111. Cosmarium glyptodermum, nov. sp.* (Pl. VII. fig. 23.) *C.* submagnum, circiter $1\frac{1}{2}$-plo longius quam latum, submodice constrictum, sinu rotundo-excavato; semicellulæ subsphærico-depressæ, apicibus leviter subtruncatis; a vertice visæ circulares; membrana depressionibus magnitudinum duarum quincuncialiter ordinatis ornata, inter 2 depressiones majores binis depressionibus minoribus, circa unam-

* This was described in the MSS. and referred to in letters as *C. sculptum*; but this name has since been occupied by Eichler and Gutwinski, De nonn. Alg. nov., Krakow, 1894, p. 169, tab. iv. fig. 22.

quamque depressionem majorem 6 depressionibus minoribus ; semicellulæ apicibus depressionibus minoribus obsessæ ; massa chlorophyllacea semicellularum laminis lateralibus 5.

Long. 74–78 μ ; lat. 49–51 μ ; lat. isthm. 35–37 μ.

Nos. 0 and 1.

This *Cosmarium* differs from all allied ones in the fact that the granulate appearance is produced by *depressions* of the membrane, and not by elevations. These depressions are of two sizes, and they are quincuncially arranged in such a manner that between each of the larger depressions, in either a vertical or diagonal line, there are *two* smaller ones; thus the smaller ones are arranged in hexagons around the larger. The hexagons formed by the larger depressions always have two of their opposite sides horizontal.

112. Cosmarium, sp. (Pl. VIII. fig. 15.) *C.* parvum $1\frac{3}{5}$-plo longius quam latum, profunde constrictum, sinu aperto et obtuso ; semicellulæ subhemisphæricæ, angulis inferioribus rotundatis ; a vertice visæ late subellipticæ et zygomorphicæ ; a latere visæ obovatæ et lateribus divergentibus rectis inæqualibus, apicibus obliquis.

Long. 28 μ ; lat. 17 μ ; lat. isthm. 7 μ ; crass. 14 μ.

No. 3.

Only one example of this species was seen.

113. Cosmarium moniliforme, Ralfs, Brit. Desmid. p. 107, tab. xvii. fig. 6.

Long. 25 μ ; lat. 14·5 μ ; lat. isthm. 4 μ. (Pl. IX. fig. 30.)

No. 1.

Var. punctatum, Lagerh. Ueber ein. Alg. aus Cuba, Jamaica und Puerto-Rico, p. 197.

Long. 24 μ ; lat. 14 μ ; lat. isthm. 3·5 μ. (Pl. IX. fig. 31.)

No. 0.

114. Cosmarium goniodes, nov. sp. (Pl. VIII. fig. 8.) *C.* parvum, duplo longius quam latum, paullo constrictum, sinu aperto ; semicellulæ subcuneato-quadratæ, lateribus rectis, angulis superioribus truncatis, apicibus levissime concavis ; a vertice visæ circulares ; membranâ glabrâ.

Long. 16–20 μ ; lat. 8–9·5 μ ; lat. isthm. 6 μ.

No. 3.

The nearest allies to this species are *C. exiguum*, Archer, *C. pseudexiguum*, Racib., and *C. moniliforme*, Ralfs.

115. Cosmarium contractum, Kirchn. Alg. Schles. p. 147.

Long. 31 μ ; lat. 23 μ ; lat. isthm. 5·7 μ ; crass. 14·5. (Pl. VIII. fig. 5.)

No. 0.

116. Cosmarium aversum, nov. sp. (Pl. VIII. figs. 6–7.) *C.* parvum, $1\frac{1}{2}$-plo longius quam latum, profunde constrictum, sinu apertissimo ; semicellulæ obsemicirculares

angulis superioribus rotundatis, apicibus truncatis; a vertice visæ subcirculares; membranâ irregulariter punctatâ; pyrenoidibus singulis.

Long. 29–31 μ; lat. 20–21 μ; lat. isthm. 6–7 μ.

No. 1.

The nearest species to this is *Cosmarium contractum*, Kirchn., from which it differs in the form of its semicells with truncate apices; the sinus is also more open, and the vertical view is very different.

117. Cosmarium zonarium, nov. sp. (Pl. VIII. fig. 13.) *C.* mediocre, circiter 1½-plo longius quam latum, leviter constrictum; semicellulæ semiellipticæ, in basi angustiores, apicibus levissime retusis; a vertice visæ circulares; membranâ scrobiculatâ, sed zonâ glabrâ trans isthmum.

Long. 72–76 μ; lat. 46–49 μ; lat. isthm. 44 μ.

No. 0.

The scrobiculations appear to have zones round them which refract the light differently to the rest of the membrane (fig. 13, *e*). This species is nearest to *Penium australe*, Racib. (Desmid. w pod. naokol. ziem. p. 7, tab. i. fig. 11), but it is more constricted and is of a different form, with more truncate apices, which are slightly retuse; the membrane is also sparsely scrobiculate and not irregularly punctate.

118. Cosmarium pseudoconnatum, Nordst. Desm. Brasil. tab. iii. fig. 17.

Long. 50 μ; lat. 38 μ.

No. 0.

119. Cosmarium viride, Josh. in Journ. Bot., Feb. 1885, tab. 254. fig. 3. (*Colpopelta viridis*, Corda, Almanach de Carlsbad, 1835, p. 206, tab. 2. fig. 28. *Cosmarium Cordanum*, Bréb. ex Rabenh Fl. Europ. Alg. iii. p. 177; *C. Colpopelta*, Bréb. in Pritch. Infus. ed. 1861, p. 734.

Long. 47–48 μ; lat. 25·5–27 μ; lat. isthm. 22–23 μ. (Pl. IX. fig. 27.)

No. 1.

120. Cosmarium conicum, nov. sp. (Pl. VIII. fig. 12.) *C.* parvum, circiter duplo longius quam latum, leviter constrictum; semicellulæ truncato-conicæ, apicibus rotundatis, lateribus subrectis, angulis basalibus rotundatis; a vertice visæ circulares; membrana punctata, seriebus transversis 2 vel 3 prope basin, ceteris irregulariter ordinatis; pyrenoidibus singulis.

Long. 37–42·5 μ; lat. 19–23 μ; lat. isthm. 18–21 μ.

No. 0.

This comes nearest to *C. Cucurbita*, Bréb., and *C. Palangula*, Bréb., but differs from them both in the form of its semicells, in its constriction and in its differently punctate membrane.

Genus Arthrodesmus, Ehrenb.; Arch.

121. Arthrodesmus subulatus, Kütz. Species Algar. p. 176. Forma spinis leviter divergentibus et membranâ delicate punctatâ.

Long. 29 μ; lat. sine spin. 27 μ, cum spin. 52 μ; lat. isthm. 7·5 μ; crass. 14·5 μ. (Pl. IX. fig. 32.)

Larger form:—

Long. 35 μ; lat. sine spin. 36·5 μ, cum spin. 75 μ; lat. isthm. 7·5 μ. (Pl. IX. fig. 32.)

Nos. 0 and 1.

In all the specimens observed the spines were slightly diverging and the membrane finely punctate.

122. Arthrodesmus arcuatus, Josh. Burmese Desmid. in Journ. Linn. Soc. Bot. vol. xxi. 1886, p. 654, t. xxiv. fig. 14. Forma paullo minor, spinis divergentioribus et longioribus.

Long. sine spin. 31 μ, cum spin. 58 μ; lat. sine spin. 29 μ, cum spin. 56 μ; lat. sthm. 9 μ; crass. 15·5 μ. (Pl. VIII. fig. 18.)

No. 1.

123. Arthrodesmus mucronulatus, Nordst. Desm. Brasil. tab. iv. fig. 58. Forma angulis superioribus semicellularum cum spinâ brevi (non mucrone).

Long. 28 μ; lat. cum spin. 40 μ, sine spin. 32·5 μ; lat. isthm. 9 μ. (Pl. VIII. fig. 16.)

No. 1.

Var. robustum, nov. var. (Pl. VIII. fig. 17.) Var. major, semicellulis ellipticioribus, spinis brevibus (non mucronibus) dorso; a vertice visis angustius ellipticis; membanâ levi.

Long. 35 μ; lat. cum spin. 57 μ, sine spin. 46 μ; lat. isthm. 13·5 μ; crass. 19 μ.

No. 1.

Genus Staurastrum, Meyen; Ralfs.

124. Staurastrum Dickiei, Ralfs, Brit. Desmid. p. 123. tab. 21, fig. 3.

Var. maximum, nov. var. (Pl. VIII. fig. 19.) Var. duplo-major, a fronte visa spinis recurvatis; membranâ minute punctatâ.

Long. 46 μ; lat. sine spin. 49 μ; cum spin. 65·5 μ; lat. isthm. 11 μ.

No. 3.

125. Staurastrum acanthophorum, nov. sp. (Pl. VIII. fig. 20.) *S.* parvum, paullo latius quam longum (sine spinis), modice constrictum, sinu acuto et aperto; semicellulæ ellipticæ, utroque fine aculeo longo recto sed convergente instructæ, irregulariter et sparsim granulatæ, circiter 12 in ambitu; a vertice visæ triangulares, granulatæ, lateribus concavis granulis circiter 6 latere unoquoque, angulo unoquoque rotundato, spinâ singulâ longâ rectâ instructæ.

Long. 17·5 μ; lat. sine spin. 19 μ; lat. cum spin. 32 μ; lat. isthm. 7 μ.

No. 3.

It differs from *S. Dickiei*, Ralfs, var. *granulatum*, Roy et Biss. (Jap. Desmid. in Journ. Bot., July 1886, p. 238), in being much smaller, in its more narrowly elliptical semicells, its longer and straighter spines, and in the coarser and more distant granules.

126. Staurastrum pseudocuspidatum, Roy et Biss. Jap. Desm. in Journ. Bot. 1886, p. 237, tab. 268. fig. 3.

Long. 21–22 μ; lat. sine spin. 15–17 μ, cum spin. 27–28 μ; lat. isthm. 5–5·5 μ. (Pl. VIII. fig. 44.)

Nos. 1 and 3.

127. Staurastrum monticulosum, Bréb. in Menegh. Syn. Desm. p. 226; Ralfs, Brit. Desmid. p. 130, t. xxxiv. fig. 9.

Var. bifarium, Nordst. Bidrag till känn. sydlig. Norges Desm. p. 31, fig. 14. Forma minor. (Pl. VIII. fig. 21.)

Long. sine proc. 19 μ, cum proc. 27 μ; lat. c. acul. 23 μ; lat. isthm. 7·5 μ.

No. 1.

128. Staurastrum fissum, W. B. Turn. Freshw. Alg. of E. India, p. 110, tab. xiv. fig. 24.

Var. perfissum, nov. var. (Pl. VIII. figs. 22, 23.) Var. paullo majus, processibus longioribus apicibus bidenticulatis; a vertice visæ lateribus concavis.

Long. 19–23 μ; lat. c. proc. 28–32·5 μ; lat. isthm. 6–7·6 μ.

No. 3.

129. Staurastrum ornithocephalum, nov. sp. (Pl. VIII. fig. 24.) *S.* parvum, paullo latius quam longum (cum processibus), modice constrictum; semicellulæ late campanulatæ, apicibus convexis cum verrucis duabus emarginatis intra marginem, angulis in processus breves productis, cum crenâ singulâ utrobique infra apices, capitatis apiculatis; a vertice visæ triangulares lateribus subconvexis, angulis productis capitatis apiculatis cum crenâ utrobique in basi, cum verrucis duabus emarginatis intra latus utrumque; membranâ glabrâ.

Long. 23 μ; lat. 26 μ; lat. isthm. 5·7 μ.

No. 0.

This *Staurastrum* seems to be unique; the two emarginate warts just within the margins of the vertical view can only be seen projecting when it is in an inclined position.

130. Staurastrum orbiculare, Ralfs, Brit. Desm. p. 125, tab. xxi. fig. 5.

Var. depressum, Roy et Biss. Jap. Desm. in Journ. Bot. 1886, p. 237, tab. 268. fig. 14.

Long. 19 μ; lat. 19 μ; lat. isthm. 7 μ.

No. 0.

Var. DENTICULATUM, Nordst. Desm. Brasil. in Kjöb. Vidensk. Meddel. 1869 (1870), p. 224.

Forma MINOR. (Pl. VIII. figs. 40, 41.)
Long. 30–31 μ; lat. 28–29 μ; lat. isthm. 9·5 μ.
Nos. 3 and 36.

131. STAURASTRUM BIENEANUM, Rabenh. Alg. no.1 410. (*S. orbiculare*, Ralfs, var. *Bieneanum*, Rabenh., Fl. Europ. Alg. iii. p. 200.)
Long. 21 μ; lat. 23–28 μ; lat. isthm. 8·5 μ.
No. 3.

132. STAURASTRUM HYPOCEPHALOPHORUM, nov. sp. (Pl. VIII. fig. 25.) *S.* parvum, paullo latius quam longum, profunde constrictum, sinu aperto; semicellulæ obtriangulares, lateribus et apicibus leve convexis, angulis subcapitatis, capitibus magnis conico-obtusis; a vertice visæ triangulares, lateribus levissime convexis, angulis subcapitatis, capitibus magnis conico-obtusis; membranâ delicatissime punctatâ.
Long. 23 μ; lat. 25 μ; lat. isthm. 7·7 μ.
No. 1.

133. STAURASTRUM PYGMÆUM, Bréb. in Ralfs, Brit. Desmid. p. 213, tab. xxxv. fig. 26; Rabenh. Fl. Europ. Algar. iii. p. 220.

Var. APICULATUM, nov. var. (Pl. VIII. fig. 26.) Var. minor, semicellulis angulis apiculatis; a vertice visis lateribus retusis, angulis apiculatis.
Long. 21 μ; lat. 25 μ; lat. isthm. 7 μ.
No. 0.

134. STAURASTRUM RUGULOSUM, Bréb. in Ralfs, Brit. Desm. p. 214, t. xxv. fig. 19. Forma semicellulis apicibus truncatis, a vertice visis lateribus plus concavis.
Long. 30 μ; lat. 37 μ; lat. isthm. 12 μ.
No. 0.

135. STAURASTRUM GLAPHYRUM, nov. sp. (Pl. VIII. fig. 27.) *S.* parvum, paullo longius quam latum (sine processibus), profunde constrictum; semicellulæ obsemicirculares, apicibus subrectis, angulis in processus glabros leviter divergentes productis, apicibus tridentatis dentibus late divergentibus; a vertice visæ triangulares, lateribus subrectis, angulis in processus glabros tridentatos productis; membranâ glabrâ.
Long. 14 μ; lat. cum proc. 29 μ, sine proc. circ. 11 μ; lat. isthm. 4·4 μ.
No. 1.

136. STAURASTRUM BIBRACHIATUM, Reinsch, Contrib. Alg. et Fung. t. xvi. fig. 2.

Var. CYMATIUM, nov. var. (Pl. VIII. fig. 28.) Var. cum processibus longioribus bidentatis clare 6-undulatis (utrobique).
Long. sine proc. 12 μ, cum proc. 46 μ; lat. cum proc. 44–46 μ; lat. isthm. 4·8–5·5 μ.
No. 3.

The body of this variety is rather smaller in proportion to the length of the arms than

that of the typical form. One abnormal example (fig. 28, *a'*) was noticed which had the upper process on one side undeveloped.

Forma BREVIOR. (Pl. VIII. fig. 29.) Forma processibus brevioribus et triundulatis (utrobique).

Long. sine proc. 11·5 μ, cum proc. 31 μ; lat. cum proc. 29 μ; lat. isthm. 5·5 μ.

137. STAURASTRUM FORCIPATUM, nov. sp. (Pl. VIII. fig. 30.) *S.* parvum, paullo longius quam latum (sine processibus), modice constrictum; semicellulæ late cuneatæ, lateribus apicibusque leve subconvexis, angulis superioribus in processus longos tenues glabros subcurvatos (leviter sigmatoideos) patentes productis, apicibus unidentatis (ut visis); a vertice visæ triangulares, lateribus subrectis, angulis in processus longos tenues glabros curvatos (ut in *S. cyrtocero*) productis, apicibus forficulatis, dentibus magnis unguiculatis nodulo interjecto.

Long. 13·5 μ; lat. sine proc. 11·5 μ; cum proc. 38·5 μ; lat. isthm. 4 μ.

No. 1.

This unique little *Staurastrum* is well characterized by its smooth arms with pincer-like apices.

138. STAURASTRUM GRACILLIMUM, nov. sp. (Pl. VIII. fig. 31.) *S.* parvum, paullo longius quam latum (sine processibus), profunde constrictum; semicellulæ obsemicirculares apicibus subconvexis, angulis superioribus in processus divergentes gracillimos undulatos attenuatos longos productis, apicibus profunde bifurcatis; a vertice visæ triangulares, lateribus subconvexis, angulis in processus gracillimos undulatos productis; membranâ glabrâ.

Long. sine proc. 13·5 μ, cum proc. 42 μ; lat. sine proc. 11·5 μ, cum proc. 46 μ; lat. isthm. 4 μ.

No. 36.

This is much smaller and more delicate than *S. paradoxum*, Meyen, var. *longipes*, Nordst. (Bidrag till känn. sydlig. Norges Desm. p. 35, t. i. f. 17); its processes also have only bifurcate apices.

Var. BIRADIATUM, n. var. (Pl. VIII. fig. 32.) Var. semicellulis latioribus; a vertice visis anguste fusiformibus, processibus rectis.

Long. sine proc. 10 μ, cum proc. 38 μ; lat. sine proc. 11·5 μ, cum proc. 50 μ; lat. isthm. 5 μ; crass. 3·8 μ.

No. 36.

139. STAURASTRUM HEXACERUM, Wittr. Om Gotl. och Öland Söttvat. Alg. p. 51. (*S. tricorne*, Menegh. in Linnæa, 1840, p. 225.)

Forma trigona.

Long. 17·5 μ; lat. 23 μ; lat. isthm. 5·5 μ.

No. 0.

Forma TETRAGONA.
Long. 19 μ; lat. 20 μ; lat. isthm. 6 μ.
No. 1.

140. STAURASTRUM INCURVATUM, nov. sp. (Pl. VIII. fig. 33.) *S.* parvum, $1\frac{1}{2}$-plo latius quam longum (cum processibus), profunde constrictum; semicellulæ urniformes, in basi inflatæ cum annulo granulorum acutorum, apicibus valde convexis granulatis, angulis superioribus in processus incurvatos undulatos et punctato-granulatos productis, apicibus tridenticulatis; a vertice visæ triangulares, lateribus concavis, in medio lateris uniuscujusque retusæ et intra marginem (in medio retusum) serie singulâ granulorum 6, angulis in processus undulatos et transverse punctato-granulatos productis; membranâ punctatâ.
Long. 23 μ; lat. cum proc. 36 μ; lat. isthm. 5·5 μ.
No. 3.

141. STAURASTRUM BASIDENTATUM, Borge, Chlorophylloph. från Norska Finmarken, p. 8, fig. 5.

Var. SIMPLEX, Borge, l. c. fig. 6. (Pl. VIII. fig. 45.)
Long. 21 μ; lat. cum proc. 31 μ; lat. isthm. 9 μ.
No. 0.

142. STAURASTRUM SUBGEMMULATUM, nov. sp. (Pl. VIII. fig. 34.) *S.* parvum, paullo latius quam longum (cum processibus), modice constrictum; semicellulæ late cuneatæ, apicibus convexis glabris, angulis superioribus in processus breves validos granulatos horizontales productis, apicibus truncatis; a vertice visæ sexradiatæ, processibus conicis granulatis truncatis, angulis inter processus subrectangularibus, in centro glabræ.
Long. 33 μ; lat. cum proc. 38 μ; lat. isthm. 10 μ.
No. 0.

This is nearest to *S. gemmulatum*, W. B. Turn. (Freshw. Alg. of E. India, p. 114, tab. xiii. fig. 26), but differs in the absence of the apical gemmules, in its smaller size, and in having the processes in front view horizontal and sparsely granulate (not striolate). Compare also with *S. polymorphum*, Bréb.

Var. GRACILIUS, nov. var. (Pl. VIII. fig. 35.) Var. semicellulis granulis paucioribus, processibus minus validis apicibus minute tridenticulatis.
Long. 27 μ; lat. cum proc. 38 μ; lat. isthm. 10 μ.
No. 0.

143. STAURASTRUM BARONII, nov. sp. (Pl. VIII. fig. 36.) *S.* parvum, paullo latius quam longum (cum processibus), profunde constrictum; semicellulæ late campanu-

latæ, apicibus rectis (prope medium) crenis binis bidenticulatis, angulis superioribus in processus bicrenatos productis, crenis acute apiculatis, apicibus tridenticulatis; a vertice visæ triangulares, lateribus concavis 6-crenatis, crenis acute apiculatis; a fronte et a vertice visæ denticulis parvis paucissimis præditæ.

Long. 27 μ; lat. cum proc. 31 μ; lat. isthm. 8·5 μ.

No. 0.

144. STAURASTRUM GRACILE, Ralfs, Brit. Desm. p. 136, tab. xxii. fig. 12.

Var. VERRUCOSUM, nov. var. (Pl. IX. fig. 1.) Var. semicellulis apicibus verrucis emarginatis ornatis; a vertice visis serie verrucarum emarginatarum intra marginem unumquemque lateralem.

Long. 35 μ; lat. cum proc. 69 μ; lat. isthm. 13·5 μ.

No. 3.

Var. CYATHIFORME, nov. var. (Pl. IX. fig. 2.) Var. semicellulis cyathiformibus subventricosis prope basin, lateribus denticulato-undulatis, apicibus convexis verrucis emarginatis ornatis, apicibus processuum dentibus minoribus; a vertice visis serie verrucarum emarginatarum intra marginem unumquemque lateralem; membranâ punctatâ.

Long. 56 μ; lat. cum proc. 88 μ; lat. isthm. 9·5 μ.

Nos. 18 and 36.

Compare with *S. gracile*, Ralfs, var. *curtum*, Nordst. (Desm. Brasil. tab. iv. fig. 53), and var. *subventricosum*, Bœrg. (Desm. Brasil. p. 952, tab. v. fig. 50).

Var. UNISERIATUM, nov. var. (Pl. IX. fig. 3.) Var. semicellularum apicibus cum granulis acutis; semicellulæ a vertice visis lateribus plus concavis, intra marginem unumquemque lateralem serie granulorum præditæ.

Long. 27 μ; lat. cum proc. 49 μ; lat. isthm. 8 μ.

No. 0.

Var. PUSILLUM, nov. var. (Pl. IX. fig. 4.) Var. minor, semicellulis a fronte et a vertice visis lateribus et processibus profunde undulatis (non denticulatis).

Long. 21 μ; lat. cum proc. 41 μ; lat. isthm. 5 μ.

No. 3.

Compare with *S. gracile*, Ralfs, var. *tenuissimum*, Boldt. (Siber. Chlorophyll. taf. v. fig. 29.)

Var. CONVERGENS, nov. var. (Pl. IX. fig. 5.) Var. semicellulis subinflatis et in basi denticulatis, apicibus convexis et subglabris, processibus curvatis et convergentibus.

Long. 29 μ; lat. cum proc. 53 μ; lat. isthm. 7·5 μ.

No. 3.

145. Staurastrum undulatum, nov. sp. (Pl. VIII. fig. 37.) *S.* parvum, circiter $1\frac{1}{2}$-plo longius quam latum (cum processibus), profunde constrictum; semicellulæ subcampanulatæ, in basi ventricosæ, apicibus truncatis et subundulatis, angulis superioribus in processus profunde undulatos productis, apicibus bidenticulatis; vertice visæ triangulares, lateribus concavis et subundulatis, angulis processibus undulatis productis apicibus unidentatis.

Long. 17 μ; lat. cum proc. 38 μ; lat. isthm. 5·5 μ.

No. 18.

146. Staurastrum excavatum, nov. sp. (Pl. VIII. fig. 42.) *S.* parvum, 3-plo latius quam longum (cum processibus), profunde constrictum, sinu aperto et obtuso; semicellulæ late campanulatæ, apicibus profunde concavis, angulis superioribus in processus longos subpatentes rectos undulatos attenuatos productis, apicibus tridenticulatis; a vertice visæ fusiformes, polis in processus leviter curvatos productis; membranâ glabrâ.

Long. 15 μ; lat. cum proc. 46 μ; lat. sine proc. circ. 12 μ; lat. isthm. 4·5 μ; crass. 6 μ.

No. 3.

This species differs from allied forms in its subpatent processes, its large apical excavation, and fusiform vertical view. It is somewhat similar to *S. paradoxum*, Meyen, var. *longipes*, W. B. Turn. (Freshw. Alg. of E. India, p. 125, tab. xv. fig. 4 c, *non* a–b, d–e), *non* Nordst. (Sydlig. Norges Desm. p. 35, fig. 17).

147. Staurastrum exile, nov. sp. (Pl. VIII. fig. 38.) *S.* parvum, pæne duplo longius quam latum (sine processibus), profunde constrictum; semicellulæ campanulatæ, apicibus minute biundulatis, angulis superioribus in processus parallelos 3-undulatos (non-granulatos) productis, apicibus subemarginatis; a vertice visæ triangulares, lateribus leve biundulatis, angulis in processus 3-undulatos productis; membranâ glabrâ.

Long. 13·5 μ; lat. cum proc. 23 μ; lat. isthm. 3 μ.

No. 3.

Compare with *S. paradoxum*, Meyen, var. *depressum*, W. B. Turn. (Freshw. Alg. of E. India, p. 125, tab. xv. fig. 5).

148. Staurastrum tenuissimum, nov. sp. (Pl. VIII. fig. 43.) *S.* parvum, circiter tam longum quam latum (sine processibus), profunde constrictum; semicellulæ obsemicirculares, apicibus subconcavis, angulis superioribus in processus longos tenuissimos curvatos divergentes et levissime undulatos productis, apicibus minute tridenticulatis; a vertice visæ triangulares, lateribus subrectis, angulis in processus tenuissimos productis, apicibus tridenticulatis; membranâ glabrâ.

Long. sine proc. 10 μ; lat. sine proc. 9·5 μ, cum proc. 32 μ; lat. isthm. 3 μ.

No. 0.

149. STAURASTRUM PSEUDOTETRACERUM, nob. (Pl. VIII. fig. 39.) (*S. contortum*, Delp., var. *pseudotetracerum*, Nordst. Freshw. Alg. of New Zeal. & Austr. p. 37, tab. iv. fig. 9.)

Long. sine proc. 19–21 μ; long. cum proc. 23–26 μ; lat. cum proc. 24–26 μ; lat. isthm. 7·5 μ.

No. 18.

150. STAURASTRUM VOLANS, nov. sp. (Pl. IX. figs. 10–11.) *S.* parvum, duplo longius quam latum (sine processibus), modice constrictum, sinu aperto et obtuso; semicellulæ cyathiformes, apicibus valde convexis, angulis superioribus in processus divergentes curvatos (sursum) profunde 5-undulatos attenuatos productis, apicibus bifurcatis; a vertice visæ globosæ, processibus binis rectis undulatis attenuatis instructæ; membranâ glabrâ.

Long. 18–19 μ; lat. sine proc. 9·5–10·5 μ, cum proc. 44–48 μ; lat. isthm. 3·8–4 μ; crass. 8–9·5 μ.

Nos. 1 and 3.

151. STAURASTRUM LEPTOCLADUM, Nordst. Desm. Brasil. p. 218, tab. iv. fig. 57.

Var. CORNUTUM, Wille, Bidrag till Sydam. Algfl. p. 19, tab. i. fig. 39.

Long. 31–33 μ; lat. cum proc. 59–82 μ; lat. isthm. 4·5–7·5 μ; crass. 13·5 μ. (Pl. IX. figs. 12–13.)

Nos. 0, 1, 3, and 36.

It is a curious fact that out of a large number of examples examined this variety only occurred, not a single specimen of the type being seen. In examining a large number of examples from the United States of America also, not one type specimen was met with; W. B. Turner remarks the same thing with regard to the Indian specimens (Freshw. Alg. of E. India, p. 123).

152. STAURASTRUM ANNULATUM, nov. sp. (Pl. IX. fig. 7.) *S.* parvum, paullo latius quam longum (cum processibus), modice constrictum; semicellulæ formâ incudis apice convexæ spinis brevibus ornatæ, apicibus processuum triaculeolatis, in basi inflatæ seriebus horizontalibus duabus granulorum (granulis superioribus majoribus) præditæ; a vertice visæ triangulares, lateribus concavis a spinis circiter 14 ornatis, intra marginem unumquemque serie spinorum, angulis in processus breves apicibus triaculeolatos productis.

Long. cum spin. 32·5 μ; lat. cum proc. 36 μ; lat. isthm. 10·5 μ.

No. 0.

This differs from *S. aculeatum*, Menegh., var. *ornatum*, Nordst. (Desmid. Spetsb. p. 40, tab. vii. fig. 27), in its smaller size, its longer processes, its fewer, shorter, and simple spines, and in its basal inflation having two rings of granules; the vertical view also has a series of spines within each lateral margin.

The numerous specimens of *Staurastrum aculeatum*, Menegh., examined from N. America and Britain agree so well with the figure given by Ralfs (Brit. Desm. tab. xxiii. fig. 2) that it is probable that the above variety of Nordstedt is another species.

153. STAURASTRUM TOHOPEKALIGENSE, Wolle, Freshw. Alg. of U.S. of Amer. p. 45, pl. 59. figs. 4, 5.

Var. TRIFURCATUM, nov. var. (Pl. IX. fig. 8.) Var. processibus paullo brevioribus, apicibus trifurcatis, dentibus validis divergentibus; processibus tribus ad angulos a fronte visis minus patentibus.

Long. sine proc. 39 μ, cum proc. circ. 70 μ; lat. sine proc. circ. 30 μ, cum proc. 70 μ; lat. isthm. 13 μ.

No. 3.

S. nonanum, W. B. Turn. (Freshw. Alg. of E. India, p. 119, t. xv. figs. 14–15), seems to be a form of this species with more globose semicells, which cause the three processes at the angles to be more distant from the base of the semicells.

Var. QUADRANGULARE, nov. var. (Pl. IX. fig. 9.) Var. processibus apicibus trifurcatis, dentibus minoribus; semicellulæ a vertice visæ quadrangulares, lateribus rectis subconcavisve.

Lat. cum proc. 52–67 μ.

No. 3.

This differs from the previous variety in its quadrangular vertical view and in the processes being more slender and not having the large trifurcate apices. *S. nonanum*, W. B. Turn., forma *quadrangulare*, W. B. Turn. (*l. c.*), is similar to this, but has shorter processes bifurcate at the apices, and the sides of the vertical view are convex.

154. STAURASTRUM TETRACERUM, Ralfs, Brit. Desm. p. 137, tab. xxiii. fig. 7.

Long. cum proc. 18–23 μ; lat. cum proc. 18–19 μ; lat. isthm. 2·5–3·5 μ; crass. 5 μ.

Nos. 1 and 3.

Var. UNDULATUM, nov. var. (Pl. IX. fig. 6.) Var. processibus distincte undulatis et apicibus processuum emarginatis.

Long. sine proc. 11 μ, cum proc. 27 μ; lat. cum proc. 27 μ; lat. isthm. 5 μ; crass. 6 μ.

No. 3.

Class *CŒNOBIEÆ.*

Order PEDIASTREÆ.

Genus PEDIASTRUM, Meyen.

155. PEDIASTRUM CONSTRICTUM, Hass. Brit. Freshw. Alg. p. 391, t. 86. figs. 15, 16; Rabenh. Fl. Europ. Alg. iii. p. 77; Cooke, Brit. Freshw. Alg. p. 42, pl. 17. fig. 2.

Diam. cœnob. 48–54 μ; diam. cell. periph. 9·5–12·5 μ.

Nos. 0 and 3.

156. PEDIASTRUM DUPLEX, Meyen, Beob. über Algenfl. p. 772. tab. 43, figs. 6–10, et figs. 16–19. (*Pediastrum pertusum*, Kütz. Phycolog. Germ. p. 143; Rabenh. Fl. Europ. Alg. iii. p. 75.)

Var. CLATHRATUM, A. Br. Alg. Unicell. p. 93; Reinsch, Algenfl. von Frank. pp. 93–94, tab. x. fig. v. (Pl. IX. figs. 41, 42.)

Diam. cœnob. 73–79 μ; diam. cell. periph. 11·5–17 μ.

Nos. 1, 3, and 18.

Var. ASPERUM, A. Br. Alg. Unicell. p. 93.

No. 0.

157. PEDIASTRUM TETRAS, Ralfs, in Ann. Nat. Hist. vol. xiv. p. 469, tab. xii. fig. 4; Brit. Desmid. p. 182, t. xxxi. fig. 1. (*Micrasterias tetras*, Ehrenb. Infusoria, p. 155, n. 182, tab. xi. fig. 1.)

Forma *a*. Dispositio cellularum 4. (Pl. IX. fig. 40.)

Nos. 1 and 3.

Forma *b*. Dispositio cellularum 1 + 7. (Pl. IX. fig. 39.)

Nos. 0, 1, 18, and 22.

158. PEDIASTRUM ENOPLON, nov. sp. (Pl. V. figs. 1, 2.) *P.* cœnobiis orbicularibus, e cellulis 16–64 formatis consociatis; cellulis periphericis late oblongis ($2\frac{1}{2}$–$3\frac{1}{2}$-plo latioribus quam longis) et curvatis, in medio exteriore cellulæ uniuscujusque spinâ longâ validâ attenuatâ ornatis, apice truncato-emarginatis; cellulis centralibus riradiatis ad fines connexis, aperturis magnis inter eas; membranâ cellularum glabrâ vel cellulis vetustis punctatâ.

Diam. cœnob. 98–160 μ; diam. cell. periph. 11·5–26 μ; long. spin. 19–27 μ; crass. spin. ad bas. 4–6 μ; crass. spin. ad apic. 1–1·8 μ.

No. 36.

This characteristic species differs from all others in the form of its cells, in its long single peripheral spines, and in the large apertures.

Order SORASTREÆ.

Genus STAUROGENIA, Kütz.

159. STAUROGENIA EMARGINATA, nov. sp. (Pl. V. fig. 25, 26.) *S.* cellulis cœnobii 2–4, paullo longioribus quam latis, subhexagonis, angulis rotundatis, lateribus retusis, apicibus profunde emarginatis. Propagatio fit cellulis filialibus quatuor in cellulâ matricali ortis.

Long. cell. 11–12 μ; lat. cell. 12·5–14·5 μ.

No. 1.

Genus CŒLASTRUM, Näg.

160. CŒLASTRUM SPHÆRICUM, Näg. (*Cœlastrum Nägelii*, Rabenh. Fl. Europ. Alg. iii. p. 79, pro parte.)

No. 3.

Class *PROTOCOCCOIDEÆ.*

Order EREMOBIÆ.

Genus Ophiocytium, Näg.

161. Ophiocytium cochleare, Näg., Rabenh. Fl. Europ. Alg. iii. p. 67.
Nos. 0 and 1.

Genus Oocystis, Näg.

162. Oocystis solitaria, Wittr. in Nordst. et Wittr. Alg. Exsic. no. 244.
Nos. 3 and 22.

163. Oocystis crassa, Wittr. l. c. no. 355.
No. 3.

164. Oocystis elliptica, West, Alg. Eng. Lake District, in Journ. Roy. Micr. Soc., Dec. 1892, p. 736, pl. x. fig. 56.

Forma minor, West, l. c. (? *Hydrocytium macrosporum*, W. B. Turn. Freshw. Alg. of E. India, p. 154, tab. xx. fig. 32.)
Long. cell. 17–22 μ; lat. cell. 7–8·5 μ; fam. 4 cell. 23×36 μ. (Pl. V. figs. 13, 14.)
No. 3.

Order PROTOCOCCACEÆ.

Genus Glœocystis, Näg.

165. Glœocystis vesiculosa, Näg. Gatt. einzell. Alg. p. 66, tab. iv. fig. F; Rabenh. Fl. Europ. Algar. iii. p. 29.
Nos. 0 and 1.

Genus Rhaphidium, Kütz.

166. Rhaphidium polymorphum, Fresen. in Abhandl. der Senckenb. naturf. Gesellsch. ii. p. 199, tab. viii.; Rabenh. Fl. Europ. Alg. tab. iii. p. 44.

Var. aciculare, Rabenh. l. c. (*Raphidium aciculare*, A. Br. in Rabenh. Alg. no. 442.)
Nos. 1 and 18.

Var. falcatum, Rabenh. l. c. (*Micrasterias falcata*, Corda, Almanach de Carlsbad, 1835, p. 121, tab. ii. fig. 29.)
No. 18.

Genus Scenedesmus, Meyen.

167. Scenedesmus bijugatus, Kütz. Syn. Diat. p. 607; Lagerh. Stockolm. Ped. Protoc. och Palmell. p. 60. (Pl. IX. fig. 38.)
Nos. 0, 3, and 18.

168. Scenedesmus denticulatus, Lagerh. Bidrag till Stockh. Ped. Protoc. och Palmell. p. 61, tab. 2. figs. 13–16.

Var. zig-zag, Lagerh. l. c. fig. 17.
No. 18.

Var. linearis, Hansg. Prodr. der Algenfl. von Böhmen, p. 268. (*Scenedesmus denticulatus*, Lagerh. var. *lineatus*, West, Freshw. Alg. of W. Ireland, p. 193, pl. xviii. fig. 7.)
Long. cell. sine dentic. 7·5–9·5 μ; lat. cell. 2–3·5 μ.
Nos. 3 and 18.

Var. lunatus, nov. var. (Pl. V. figs. 11, 12.) Var. cellulis 2–4 in seriem rectam dispositis, cellulis medianis ellipticis rectis, terminalibus extrorsum lunatis; apicibus cellularum 3-denticulatis.
Long. cell. 9·5–11 μ; lat. cell. 3·5–4 μ.
No. 3.

169. Scenedesmus quadricauda, Bréb., Ralfs, Brit. Desmid. p. 190, tab. xxxi. fig. 12 *a–f*. (Pl. V. figs. 4, 5.)
Nos. 0, 1, 3, 18, and 22.

Var. abundans, Kirchn. Alg. Schles. p. 98.
No. 3.

Var. maximum, nov. var. (Pl. V. figs. 9, 10.) Var. duplo-major, cellulis crassis, spinis longis validis extrorsum curvatis.
Long. cell. 27–36 μ; lat. cell. 9–11·5 μ.
Nos. 3 and 36.

Var. insignis, nov. var. (Pl. V. figs. 7, 8.) Var. cellulis 4 in seriem rectam dispositis, unaquæque cellula cum spirâ brevi singulâ, 2 simul ad dexteram, 2 simul ad sinistram, cellulis terminalibus spinâ singulâ longâ sigmoideâ alternatim dispositâ; membranâ punctato-granulatâ.
Long. cell. 10·5–12·5 μ; lat. cell. 4–5 μ.
No. 3.

Var. ellipticum, nov. var. (Pl. V. fig. 6.) Var. cellulis perfecte ellipticis, 4 in seriem rectam dispositis, cellulis terminalibus spinis binis validis curvatis extrorsum, cellulis medianis spinâ singulâ curvatâ extrorsum alternatim dispositâ ornatis.
Long. cell. 14·5–15 μ; lat. cell. 7·5 μ.
No. 1.

170. Scenedesmus obliquus, Kütz. Syn. Diat. p. 609; Lagerh. Pediast. Protoc. och Palmell. p. 64. (*Achnanthes obliqua*, Turp. *Scenedesmus acutus*, Meyen, Ralfs, Brit. Desm. tab. xxxi. fig. 14; Näg. Gatt. einzell. Alg. tab. v. A. fig. 3.)

Var. DIMORPHUS, Rabenh. Fl. Europ. Alg. iii. p. 64. (*Achnanthes dimorpha*, Turp.)
Nos. 0 and 1.

Genus TETRAËDRON, Kütz.

171. TETRAËDRON MINIMUM, Hansg. in Hedwigia, 1888, p. 131. (*Polyedrium minimum*, A. Br. Alg. Unicell. p. 94.)
Diam. cell. 7·5–11·5 μ; crass. cell. 6·5 μ.
Forma 3-gona.
Forma 4-gona.
Forma 5-gona. (Pl. V. fig. 18.)
No. 3.

Forma APICULATUM, Reinsch, Familiæ Polyedriarum Monographia, in Notarisia, 1888, no. 11, p. 499, tab. iv. fig. 2 *c*.
Diam. cell. 9·5–13·5 μ; crass. cell. 5·5 μ. (Pl. V. fig. 19.)
Nos. 3 and 36.

172. TETRAËDRON TUMIDULUM, Hansg. in Hedwigia, 1889, p. 18. (*Polyedrium tumidulum*, Reinsch, l. c. p. 506, tab. vi. fig. 3 *b*.)
Forma. Diam. 17–23 μ. (Pl. V. fig. 20.)
No. 36.

173. TETRAËDRON REGULARE, Kütz. Phycolog. Germ. p. 129. (*Polyedrium tetraëdricum*, Näg. Gatt. einzell. Alg. p. 84, tab. iv. B. fig. 3.)
Diam. cell. cum spin. 21–23 μ, sine spin. 19–20 μ.
No. 0.

174. TETRAËDRON PENTAËDRICUM, nov. sp. (Pl. V. figs. 15–16.) *T.* cellulis parvis pentaëdricis, lateribus concavis, angulis subrotundatis, a spinis singulis curvatis instructis.
Diam. sine acul. 10–15 μ; diam. cum acul. 17–25 μ; long. acul. 4·5–5·5 μ.
No. 3.

Forma MINIMA. (Pl. V. fig. 17.)
Diam. sine acul. 6 μ; diam. cum acul. 10 μ.
No. 3.

Class *PHYCOCHROMACEÆ.*

Order RIVULARIACEÆ.

Genus GLŒOTRICHIA, J. Ag.

175. GLŒOTRICHIA PISUM, Thuret, Essai de classif. des Nostoc. in Ann. des Sc. Nat. Bot. sér. vi. i. p. 382; Bornet et Flahault, Révis. des Nostoc. Hétérocycl. p. 366.
Crass. fil. 10·5–12 μ; crass. trich. 6–7 μ.
No. 3.

Order SCYTONEMACEÆ.

Genus Tolypothrix, Kütz.

176. Tolypothrix tenuis, Kütz. Phycolog. general. p. 228; Tabulæ Phycolog. ii. p. 9, tab. 31. fig. 11. (*Tolypothrix pygmæa*, Kütz.)
No. 3.

Order SIROSIPHONIACEÆ.

Genus Hapalosiphon, Näg.

177. Hapalosiphon Baronii, nov. sp. (Pl. V. figs. 21–24.) *H.* thallo cæspitoso, aquatico, circiter 1 mm. lato; filis primariis dense intricatis, ramosis (interdum dense ramosis), ramis unilateralibus, e cellulis singulis passim binis rotundo-quadratis vel subglobosis, vaginâ amplâ, hyalinâ et achroâ, formatis; filis secundariis brevibus, numerosis, passim adpressis, e cellulis singulis ut in ramulis primariis formatis; heterocystis subquadratis intercalaribus.
Crass. fil. 7·5–10 μ; diam. cell. 3·8–5 μ.
No. 3.

This species is nearest to *H. pumilus*, Kirchn. (Alg. Schles. p. 231) [=*Hapalosiphon Braunii*, Näg. in Kütz. Species Algar. p. 313], but differs in its much smaller size, in the primary filaments and the branches being of equal thickness, as well as in its shorter subglobose cells.

Order OSCILLARIACEÆ*.

Genus Spirulina, Turp.

178. Spirulina major, Kütz. Phycolog. general. p. 183; Gomont, Monographie des Oscillariées, p. 271, pl. vii. fig. 29. (*S. oscillarioides*, Kutz. Tabulæ Phycolog. i. p. 26, tab. 37, fig. 8.)
Crass. fil. 1·5 μ; anfractibus inter se 8·5 μ distantibus.
No. 3.

Order CHROOCOCCACEÆ.

Genus Merismopedia, Meyen.

179. Merismopedia violacea, Kütz. Species Algar. p. 472.
No. 3.

Genus Tetrapedia, Reinsch.

180. Tetrapedia morsa, nov. sp. (Pl. V. fig. 3.) *T.* minutissima, circiter tam longa quam lata, modice constricta, sinu semielliptico; semicellulæ subrect-

* "Gomont has shown that the priority of name belongs to *Oscillatoria*, Vauch., rather than to *Oscillaria*, Bosc, and the correct name of the order is therefore Oscillatoriaceæ."—A. W. Bennett, *in litt.*

angulares, lateribus rectis leviter divergentibus, apicibus in medio retusis; a vertice visæ ellipticæ, polis acutis; a latere visæ ellipticæ, polis acutis, sed in medio utrobique leviter constrictis.

Long. 6 μ; lat. 7·2 μ; crass. 3 μ.

No. 3.

181. TETRAPEDIA GLAUCESCENS, Boldt. (? *Arthrodesmus glaucescens,* Wittr. Gotl. och Ölands Sötvatt. Alg. p. 55, tab. iv. fig. 14.)

Long. 11 μ; lat. 11·5 μ; crass. 6 μ. (Pl. IX. fig. 37.)

No. 18.

EXPLANATION OF THE PLATES.

a, a′, a″	= cellula vel semicellula a fronte visa.			
b, b′	=	„	„	vertice „
c, c′	=	„	„	latere „
d	=	„	„	basi „

PLATE V.

Fig. 1, 2. *Pediastrum enoplon,* n. sp. 520/1.
3. *Tetrapedia morsa,* n. sp. 830/1.
4, 5. *Scenedesmus quadricauda,* Bréb. 520/1.
6. „ „ var. *ellipticum,* n. var. 520/1.
7, 8. „ „ var. *insignis,* n. var. 520/1.
9, 10. „ „ var. *maximum,* n. var. 520/1.
11, 12. „ *denticulatus,* Lagerh., var. *lunatus,* n. var. Fig. 11, 830/1; fig. 12, 520/1.
13, 14. *Oocystis elliptica,* West, forma *minor,* West. 520/1.
15, 16. *Tetraëdron pentraëdricum,* n. sp. 520/1.
17. „ „ forma *minima.* 830/1.
18. „ *minimum,* Hansg. 520/1.
19. „ „ forma *apiculatum,* Reinsch. 520/1.
20. „ *tumidulum,* Hansg., forma. 520/1.
21–24. *Hapalosiphon Baronii,* n. sp. 520/1.
25, 26. *Staurogenia emarginata,* n. sp. 520/1.
27. *Cylindrocystis crassa,* De Bary, var. *elliptica,* n. var. 520/1.
28. *Penium,* sp. 520/1.
29. „ sp. 520/1.
30. *Docidium Baculum,* Bréb. 520/1.
31. „ *Manubrium,* n. sp. 520/1.
32. *Pleurotænium moniliferum,* n. sp. *a,* 220/1; *a′,* 595/1.
33. „ *subcoronulatum* (Turn.). 520/1.
34. „ *parallelum,* n. sp. *a,* 120/1; *a′* et *a″,* 520/1.
35. „ *basiundatum,* n. sp. 520/1.
36. *Penium delicatulum,* Josh., var. *minor,* n. var. 520/1.

Fig. 37. *Closterium pachydermum*, n. sp. *a*, 120/1 ; *a'*, 520/1.
38. „ *Leibleinii*, Kütz., forma. 520/1.
39. „ *Pseudodianæ*, Roy, forma. 520/1.
40. *Pleurotænium Ehrenbergii*, De Bary, forma. 520/1.
41. „ *firmum*, n. sp. 520/1.
42. „ *ligatum*, n. sp. 520/1.

Plate VI.

Fig. 1. *Micrasterias Crux-Melitensis*, Ralfs, var. *evoluta*, Turn. 520/1.
2–4. „ *mahabuleshwarensis*, Hobson, var. *tetracerum*, n. var. 520/1.
5. „ *pinnatifida*, Ralfs, var. *incudiformis*, n. var. 520/1.
6. *Euastrum subrostratum*, n. sp. 520/1.
7. „ *bellum*, Nordst., var. *madagascariense*, n. var. 520/1.
8. „ *hypochondroides*, n. sp. 520/1.
9. „ „ var. *irregularis*, n. var. 520/1.
10. „ n. sp. 520/1.
11. „ *sympageum*, n. sp. 520/1.
12. „ *spinulosum*, Delp. **africanum*, Nordst., var. *duplo-minor*, n. var. forma. 520/1.
13. „ „ „ var. *duplo-minor*, n. var. 520/1.
14. „ *monocyclum*, Racib., var. *æquilobum*, n. var. 520/1.
15. „ *obesum*, Josh., var. *subangulare*, n. var. 520/1.
16. „ *rostratum*, Ralfs, * *umbonatum*, n. subsp. 520/1.
17. „ „ „ var. *ornatum*, n. var. 520/1.
18. „ *elegans*, Kütz., var. *madagascariense*, n. var. 520/1.
19. „ *personatum*, n. sp. 520/1.
20. „ *pyramidatum*, West, var. *incrassatum*, n. var. 520/1.
21. „ *denticulatum*, Gay, var. *rectangulare*, n. var. 520/1.
22. „ *trigibberum*, n. sp. 520/1.
23. „ *cosmarioides*, n. sp. 520/1.
24. *Cosmarium pulvinatum*, n. sp. 520/1.
25. „ *Pseudobroomei*, Wolle, var. *elegans*, n. var. 520/1.
26. „ *trachydermum*, n. sp. 521/1.
27. „ *scabratulum*, n. sp. 521/1.
28, 29. „ *inæqualipellicum*, n. sp. 520/1.
30. „ „ forma *minor*. 520/1.
31. „ *subauriculatum*, n. sp. 520/1.
32. „ *geometricum*, n. sp. 520/1.
33. „ *Sinostegos*, Schar., var. *obtusis*, Gutw., forma. *a*, *b*, etc., 830/1 ; *a'*, 520/1.
34. „ *submamillatum*, n. sp. 520/1.
35. „ *mamilliferum*, Nordst., var. *madagascariense*, n. var. 520/1.
36. „ *bireme*, Nordst., var. *crassum*, n. var. 520/1.
37. „ „ var. *rotundatum*, n. var. 520/1.
38. „ *quadrogranulatum*, n. sp. 520/1.
39. „ *Regnellii*, Wille, *madagascariense*, n. var. 520/1.
40. „ *subprotuberans*, n. sp. 520/1.
41. „ *Meneghinii*, Bréb. 520/1.
42, 43. „ *Pseudoregnesii*, n. sp. 520/1.
44. „ *Regnesii*, Reinsch. 520/1.

Plate VII.

Fig. 1. *Cosmarium notochondrum*, n. sp. 520/1.
2. „ *taxichondrum*, Lund. 520/1.
3. „ „ var. *emarginatum*, n. var. 520/1.
4. „ „ var. *subundulatum*, Boldt, forma *subdenticulatum*. 520/1.
5. „ „ var. *dentatum*, n. var. 520/1.
6. „ „ var. *compressum*, n. var. 520/1.
7. „ *Anax*, n. sp. *a* et *b*, 520/1; *c*, portion of membrane, 830/1.
8. „ *beatum*, n. sp. 520/1.
9. „ *bellum*, n. sp. 520/1.
10. „ *eximium*, n. sp. 520/1.
11. „ *creperum*, n. sp. 520/1.
12. „ *dichondrum*, n. sp. 520/1.
13. „ *haaboliense*, Wille, var. *protractum*, n. var. 520/1.
14. „ *isthmochondrum*, Nordst., var. *biseriatum*, n. var. 520/1.
15. „ *elaboratum*, n. sp. 520/1.
16. „ *subspeciosum*, Nordst., var. *effigiatum*, n. var. 520/1.
17. „ *trachypleurum*, Lund., var. *spinosum*, n. var. 520/1.
18. „ *Kirchneri*, Bœrg., var. *uniforme*, n. var. 520/1.
19. „ *rostellum*, n. sp. 520/1.
20. „ „ forma *minor*. 520/1.
21. „ *decoratum*, n. sp. 520/1.
22. „ *subspeciosum*, Nordst., var. *truncatum*, n. var. 520/1.
23. „ *glyptodermum*, n. sp. 520/1.
24. „ *tripapillatum*, n. sp. 520/1.
25. „ „ var. *alastrense*, n. var. 520/1.
26. „ *spyridion*, n. sp. *a*, *a'*, *b*, et *c*, 520/1; *a''*, 830/1.
27. „ *triordinatum*, n. sp. 520/1.
28. „ *punctulatum*, Bréb., var. *ornatum*, Istv. 520/1.
29. „ *scitum*, n. sp. 520/1.
30. „ *Baronii*, n. sp. 520/1.
31. „ *subalatum*, n. sp. 520/1.
32. „ *abruptum*, Lund., var. *granulatum*, n. var. 520/1.
33. „ *creperum*, n. sp., var. *compressum*, n. var. (cum zygosp.). 520/1.
34. „ *Pseudobroomei*, Wolle, var. *madagascariense*, n. var. 520/1.

Plate VIII.

Fig. 1. *Cosmarium sublatere-undatum*, n. sp. 520/1.
2. „ *Lundellii*, Delp., var. *madagascariense*, n. var. 520/1.
3. „ „ var. *subangulare*, n. var. 520/1.
4. „ *granatum*, Bréb., var. *angulare*, n. var. 520/1.
5. „ *contractum*, Kirchn. 520/1.
6, 7. „ *aversum*, n. sp. 520/1.
8. „ *goniodes*, n. sp. *a*, 830/1; *a'*, *a''*, et *b*, 520/1.

Fig. 9. *Cosmarium planum*, n. sp. 520/1.
10. „ *minimum*, n. sp. 830/1.
11. „ „ var. *subrotundatum*, n. var. 520/1.
12. „ *conicum*, n. sp. 520/1.
13. „ *zonarium*, n. sp. *a*, *a'*, et *b*, 520/1; *c*, portion of membrane, 830/1.
14. „ *emarginatum*, n. sp. *a*, *b*, et *c*, 830/1; *a'* et *a''*, 520/1.
15. „ sp. 520/1.
16. *Arthrodesmus mucronulatus*, Nordst., forma. 520/1.
17. „ „ var. *robustum*, n. var. 520/1.
18. „ *arcuatus*, Josh., forma. 520/1.
19. *Staurastrum Dickiei*, Ralfs, var. *maximum*, n. var. 520/1.
20. „ *acanthophorum*, n. sp. 520/1.
21. „ *monticulosum*, Bréb., var. *bifarium*, Nordst., forma *minor*. 520/1.
22, 23. „ *fissum*, W. B. Turn., var. *perfissum*, n. var. 520/1.
24. „ *ornithocephalum*, n. sp. 520/1.
25. „ *hypocephalophorum*, n. sp. 520/1.
26. „ *pygmæum*, Bréb., var. *apiculatum*, n. var. 520/1.
27. „ *glaphyrum*, n. sp. 520/1.
28. „ *bibrachiatum*, Reinsch, var. *cymatium*, n. var. 520/1.
29. „ „ „ „ forma *brevior*. 520/1.
30. „ *forcipatum*, n. sp. 520/1.
31. „ *gracillimum*, n. sp. 520/1.
32. „ „ var. *biradiatum*, n. var. 520/1.
33. „ *incurvatum*, n. sp. 520/1.
34. „ *subgemmulatum*, n. sp. 520/1.
35. „ „ var. *gracilius*, n. var. 520/1.
36. „ *Baronii*, n. sp. 520/1.
37. „ *undulatum*, n. sp. 520/1.
38. „ *exile*, n. sp. 520/1.
39. „ *pseudotetracerum*, nob. 520/1.
40, 41. „ *orbiculare*, Ralfs, var. *denticulatum*, Nordst., forma *minor*. 520/1.
42. „ *excavatum*, n. sp. 520/1.
43. „ *tenuissimum*, n. sp. 520/1.
44. „ *pseudocuspidatum*, Roy et Biss. 520/1.
45. „ *basidentatum*, Borge, var. *simplex*, Borge. 520/1.

Plate IX.

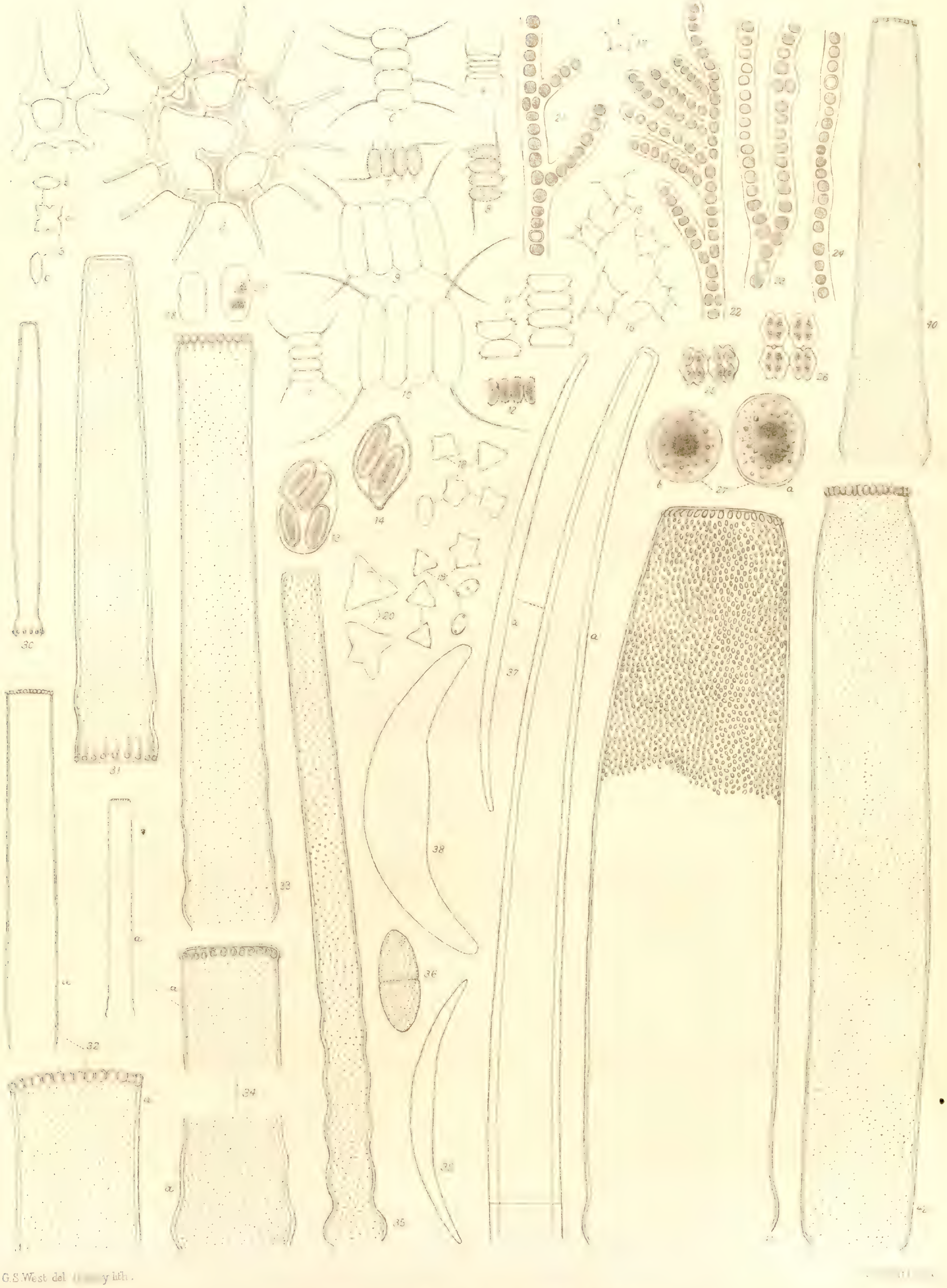
Fig. 1. *Staurastrum gracile*, Ralfs, var. *verrucosum*, n. var. 520/1.
2. „ „ var. *cyathiforme*, n. var. 520/1.
3. „ „ var. *uniseriatum*, n. var. 520/1.
4. „ „ var. *pusillum*, n. var. 520/1.
5. „ „ var. *convergens*, n. var. 520/1.
6. „ *tetracerum*, Ralfs, var. *undulatum*, n. var. 520/1.
7. „ *annulatum*, n. sp. 520/1.
8. „ *tohopekaligense*, Wolle, var. *trifurcatum*, n. var. 520/1.
9. „ „ var. *quadrangulare*, n. var. 520/1.

Fig. 10, 11. *Staurastrum volans*, n. sp. 520/1.
12, 13. „ *leptocladum*, Nordst., var. *cornutum*, Wille. 520/1.
14. *Euastrum binale*, Ralfs. 520/1.
15, 16. „ *denticulatum*, F. Gay, forms. 520/1.
17. „ *ansatum*, Ralfs. 520/1.
18. „ „ var. *pyxidatum*, Delp., forma. 520/1.
19. *Spondylosium papillosum*, n. sp. 520/1.
20. *Closterium lagoense*, Nordst., var. *læve*, n. var. 520/1.
21. „ *lanceolatum*, Kütz. 120/1.
22. *Cosmarium pseudoprotuberans*, Kirchn., var. *angustius*, Nordst. 520/1.
23. „ *concinnum*, Reinsch. 520/1.
24. „ *Regnesii*, Reinsch, var. *tritum*, West. 830/1.
25. „ *ellipsoideum*, Elfv., forma *minor*, Anders. 520/1.
26. „ *tithophorum*, Nordst., forma. 520/1.
27. „ *viride*, Josh. 520/1.
28, 29. „ *sulcatum*, Nordst. 520/1.
30. „ *moniliforme*, Ralfs. 520/1.
31. „ „ var. *punctatum*, Lagerh. 520/1.
32, 33. *Arthrodesmus subulatus*, Kütz., forma. 520/1.
34. *Desmidium Swartzii*, Ag., var. *quadrangulatum*, Roy. 520/1.
35. „ „ var. *amblyodon*, Rabenh. 520/1.
36. „ *Baileyi*, De Bary, *a. genuina*, Nordst. 520/1.
37. *Tetrapedia glaucescens*, Boldt. 520/1.
38. *Scenedesmus bijugatus*, Kütz. 520/1.
39, 40. *Pediastrum tetras*, Ralfs. 520/1.
41, 42. „ *duplex*, Meyen, var. *clathratum*, A. Br. 520/1.

Note to p. 41.—Since this paper was presented to the Society, we have received information from the Rev. R. Baron as to the localities. No. 0 was from the neighbourhood of Antananarivo; the remainder, with the exception of No. 36, mentioned on p. 41, were collected in the immediate vicinity of Lake Alastra.

Notes to pp. 59, 60.—Since the description of *Cosmarium Pseudoregnesii* (n. 80) was drawn up, a paper by Eichler and Gutwinski has appeared—'De nonnullis spec. Algar. nov.,' Krakow, 1894; in this is figured and described (p. 170, t. 5. f. 27) a new variety (var. *polonicum*) of *C. Novæ-Semliæ*. This is evidently the same as that we have described, and in our opinion not closely related to *C. Novæ-Semliæ*. As there is already a *C. polonicum*, Racib., our name must stand.

Cosmarium latere-undatum, Roy, MSS. sub n. 81. Recently Messrs. Roy and Bissett's 'Scottish Desmids' has appeared, but *latere-undatum* has been changed to *garrolense*, Roy & Bissett (Scottish Desm. p. 34, t. 2. f. 4).



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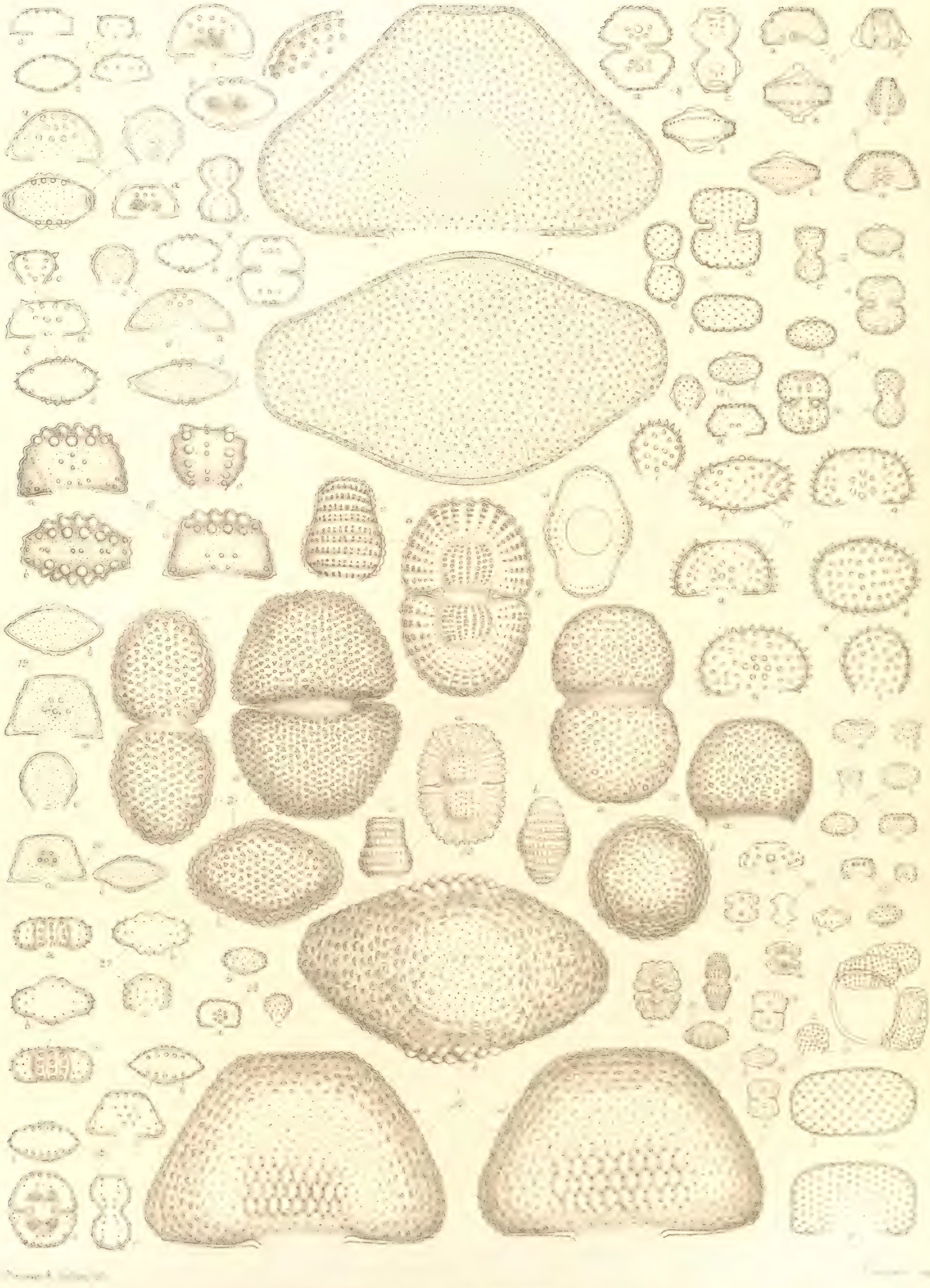

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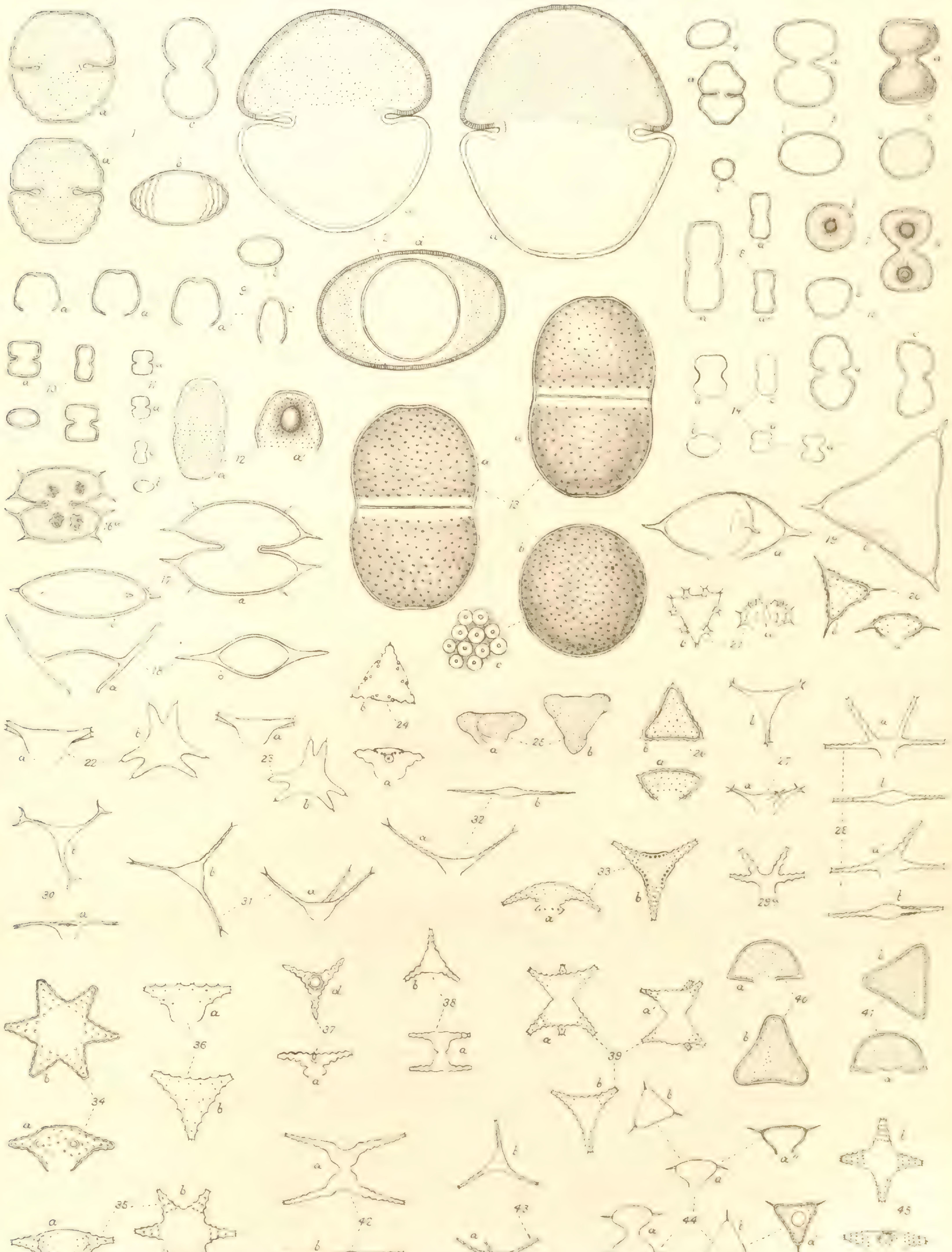

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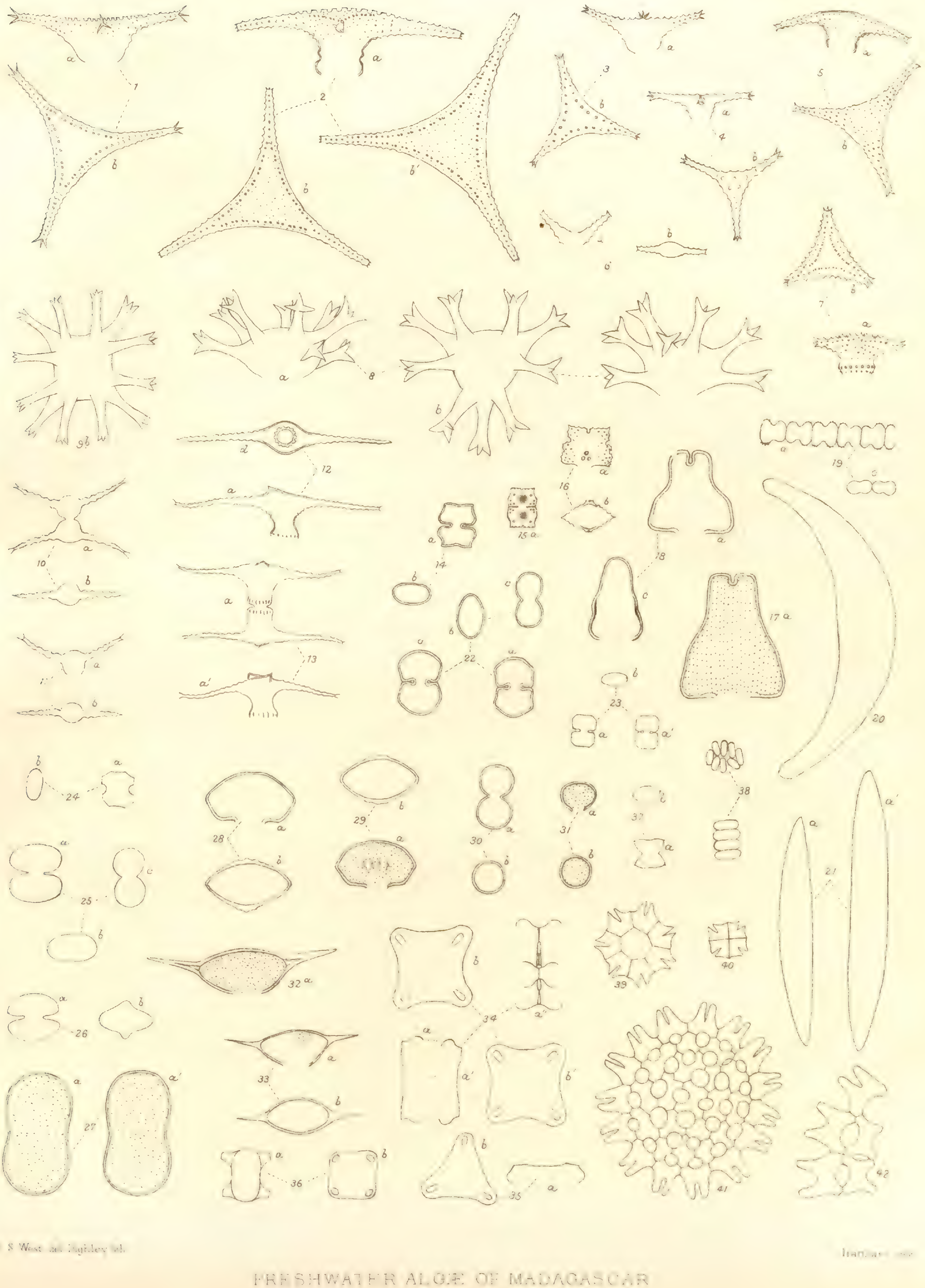

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	Part IV.	1891.	0	6	0	0	4	6
	Part V.	1891.	0	6	0	0	4	6
	Part VI.	1891.	0	3	6	0	2	8
	Part VII.	1892.	0	6	0	0	4	6
	Part VIII.	1893.	0	6	0	0	4	6
	Part IX.	1893.	1	8	0	1	1	0
	Part X.	1894.	0	10	0	0	7	6
	Part XI.	1894	0	3	4	0	2	6
IV.	Part I.	1894.	1	0	0	0	15	0
	Part II.	1894.	2	0	0	1	10	0
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OBSERVATIONS ON THE LORANTHACEÆ OF CEYLON.

BY

F. W. KEEBLE, B.A.,

FRANK SMART STUDENT, GONVILLE AND CAIUS COLLEGE, CAMBRIDGE.

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(Plates X. & XI.)

Read 18th April, 1895.

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The following paper places on record a number of observations made during a short stay in Ceylon in 1894. It is my hope to supplement this by another contribution dealing more particularly with the anatomical problems presented by some members of the Loranthaceæ here treated of.

My visit to Ceylon was rendered possible by a grant of money made to me by the University of Cambridge from the Wortz fund.

I beg to express my warmest thanks to Mr. Henry Trimen, the Director of the Royal Botanical Garden of Peradeniya, whose advice and assistance were invaluable; also to Mr. Francis Darwin, who has, by his criticism, helped me considerably in the writing of this paper.

I.—The Fertilization of the Flower.

Many Cingalese members of the genus *Loranthus* have large and conspicuous flowers; in such the corolla is brightly coloured, more or less tubular, and generally 5-lobed (figs. 1 *c*, 6, Pl. X.; 11, Pl. X.; 3, 10, Pl. XI.).

Since certain deviations from the typical regularity of the corolla-tube occur, and since these deviations have relations with the mode of fertilization of the flower, the chief will now be enumerated:—

L. loniceroides, Linn.: pink fleshy corolla, tube split less than in other species (thus Hooker gives corolla split one third way down*); stamens form a *ring* round the pistil, which in the open flower projects beyond them.

L. capitellatus, Wight & Arn.: the nearest ally to above species; the lobes of the corolla are carried further down the tube, which is consequently less marked. The 'Flora of British India' gives corolla $\frac{1}{4}$–$\frac{2}{3}$ in., funnel-shaped, cleft to or below the middle into 5–6 lobes†; here, too, the stamens form a ring round the pistil (fig. 10, Pl. XI.). The

* Hooker, Fl. Brit. India, vol. v. p. 221. † *Loc. cit.*

flowers of these two species are more *regular* than those of most other Cingalese Loranths.

Loranthus Gardneri, Thw.: flower when open is regular, the stamens form a ring, the corolla splits to 5 lobes, recurved about middle (fig. 6, Pl. X.).

L. neelgherrensis, Wight & Arn. (fig. 1 *c*, Pl. X.): the corolla-lobes are very long, "lobes much longer than tube, reflexed above the middle," and "one or two of the lobes at times combined for half their length" *. By this fusion of several lobes, the flower, on opening, has a slightly zygomorphic appearance, inasmuch as, in the reflexion of the lobes, the space between the two which are not fused forms a sort of throat (fig. 1, Pl. X.), all the lobes being bent back, away from this throat. A further result of this mode of opening out of the flower is that the stamens, from forming a ring round the style, come to form a row behind it.

In many of the Cingalese species a slit, similar in origin to that in the flower of the last species, occurs in the corolla-tube, whereby, at the time of opening, the upper part of the tube by growth of its inner surface opens out laterally, so that all the five lobes, whose inner surfaces also at the same time grow more rapidly than their outer, come to stand in a row, and the stamens also which arise from the bases of the lobes similarly stand side by side.

The slit is well marked in *Loranthus Scurrula*, Linn., *L. buddleoides*, Thw., *L. tomentosus*, Heyne (fig. 1, Pl. XI.), *L. cuneatus*, Heyne (fig. 3, Pl. XI.), *L. suborbicularis*, Thw., *L. longiflorus*, Desr. (fig. 11, Pl. X.), *L. lonchiphyllus*, Thw., *L. sclerophyllus*, Thw.

The effect of the slit is, as is illustrated in the figures (*cf.* fig. 1 *b*, Pl. XI.), to turn the regular flower into what might perhaps be called a physiologically zygomorphic one, by enabling the upper intact part of the tube to flatten itself out in the way just described.

A similar opening out of an originally tubular corolla occurs, as is well known, in some species of *Anigosanthos*, Labill., a genus of Hæmodoraceæ.

In enquiring into the significance of these slits it must be remembered that, as other observers have already shown, these tube-flowered Loranths are bird-fertilized †. My own observations confirm this, for in Ceylon the common honey-sucker, a species of *Nectarinia*, is always to be found, especially in the early morning, visiting these flowers.

I shot some of these birds which were busy in a *Loranthus* bush and found their beaks covered with pollen. Whether other birds also act as carriers of *Loranthus* pollen I could not determine. Now birds are less precise in their methods than butterflies, and the pollen-carriers—their beaks—are much larger and by no means symmetrical. By the spreading slit or throat a bird's beak has ample space to reach the nectar which fills the bottom of the tube. Thus the natural slit saves the flower to some extent, but not wholly, from being torn. Further, the arrangement of the stamens side by side, rendered possible by the opening out of the part of the corolla-tube above the slit, has the

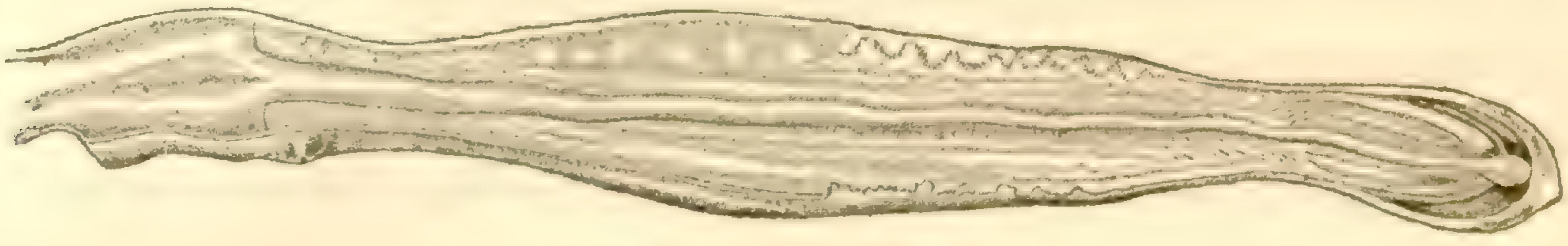
* Hooker, Fl. Brit. India, vol. v. p. 216.

† *Cf.* Wallace, 'Darwinism:' "In Australia and New Zealand . . . *Loranthus* (&c.) . . . are cross-fertilized by birds" (p. 320).

important effect of exposing the dehiscent surfaces of all five stamens to one side (the upper) of the bird's beak, so that the pollen is rubbed on the whole of that surface. Since the stigma, projecting beyond the stamens, is so placed that it too will touch this upper surface, it is clear that the confinement of the pollen to this surface, effected in the manner just described, tends to render pollination more certain. A further movement in some species adds to the apparently irregular form of the flower. In such species as *Loranthus cuneatus*, *L. tomentosus*, and *L. suborbicularis* (figs. 1 *b*, 3 *c*, Pl. XI.) the filaments bend down almost at right angles to their points of insertion, so that the anthers stand over the "throat." The style bends similarly down and projects beyond the stamens, so that self-fertilization is largely insured against.

In the bud the style is sinuous, owing to its length being greater than that of the corolla; on the opening of the latter the style straightens out (*cf.* woodcut 1 *a* with fig. 11, Pl. X.). In the species *L. longiflorus*, to which these figures refer, the style, whilst in

Fig. 1.


a

b

the bud, is included in the staminal ring and is surrounded by downwardly-pointing hairs which arise from the bases of the anthers (see woodcut 1 *b*). That the style does straighten out in the bud, thereby tending to open the flower, seems to indicate that, in this species, the order of events is the opening of the flower, separation and reflexion of the lobes, whereby the stamens are separated one from another, and, in consequence, release of the style. The significance of the style's non-assistance in the opening of the flower will be seen later. In the Loranths of Ceylon nectar is very plentiful; it often, in such species as *L. longiflorus*, fills the corolla-tube, from whose general surface it seems to be secreted. In addition to this nectar, a drop is lodged in *L. longiflorus* behind the base of each filament between it and the corolla-lobe.

In such species as *L. longiflorus*, whilst the flower is yet closed, slits appear between the bases of the corolla-lobes (fig. 11, Pl. X.). They gradually widen, making five narrow inlets, whereby small insects can and do get to the honey; the pollen, however, remains protected by the closed upper parts of the corolla-lobes.

The cleft or throat already described, which occurs in the corolla-tubes of various species, is no doubt correlated with the growth of the inner surface of the upper part of

the tube, whereby this latter flattens out. That it has a direct value in preventing the corolla's tube from rough usage on the part of the visiting nectar-seeking bird, is rendered probable by the fact that the base of the cleft is often prolonged by a jagged tear, the work of the bird visitor. This tearing, it will be at once admitted, would be much greater were no wide cleft present. In *Loranthus loniceroides* many flowers, and even buds, show at the base of the corolla irregularly oval holes which are made by birds' bills. The case is interesting, for, as is well known, many flowers are similarly pierced by *bees*, e. g. *Erica Tetralix*, Linn., *Trifolium pratense*, Linn., &c.*

In those species of *Loranthus* which have a deep throat-like cleft in the corolla-tube, such robberies, whereby the pollen-carrying is evaded, do not occur.

Having thus described the peculiarities of the flower, its regularity in the bud (with the exception often of a gibbous inflation of the tube in such species as *L. tomentosus*, &c.), and especially the curious basifugal way of opening in *L. longiflorus*, *L. neelgherrensis*, &c., it now remains to mention what is the most interesting feature, and one which gives significance to the basal separation of the lobes of the corolla.

The most noticeable appearance in a bush of *L. loniceroides* is the large number of fully mature flower-buds contrasted with the number of open flowers. The explanation is simple. The flower-bud of *L. loniceroides*, though fully developed in all respects, remains closed. If the apex of the corolla of such a flower-bud be gently struck, the lobes fly apart, exposing stigma and ripe pollen-bearing stamens. These lobes, once released, continue, by growth of their inner surfaces, to bend backward till they are reflexed on themselves (fig. 11, Pl. X., and fig. 3, Pl. XI., &c.); and there is no doubt that fully developed flower-buds remain closed, when all that is required for the release of the adherent apices of the lobes is a gentle tap. Such a tap is provided by the fertilizing agent, a bird (a species of *Nectarinia*); and I would suggest that this remaining closed of the ripe flowers is an instance of close relationship, beneficial to both "parties," between flower and fertilizer; the bird knows it is worth its while to "tap a new barrel" as it were; moreover, the parts of the flower are protected from the damaging effects of exposure to wet.

Such *exploding flowers* are by no means confined to this species (*L. loniceroides*), but in a more or less degree characterize the Cingalese large-flowered Loranths, *e. g.*:—

L. longiflorus: corolla less fleshy and less rigid than *L. loniceroides*, so explosions less vigorous (fig. 11, Pl. X.).

L. neelgherrensis and *L. cuneatus*: smaller flowers than above; basifugal slits occur between lobes; explosions small, but none the less efficient (fig. 1 *c*, Pl. X., & fig. 3 *a–e*, Pl. XI.).

L. suborbicularis, *L. tomentosus*: explosions well marked, especially in the variety *lanuginosus* of the latter, in whose flowers the noise of the separating lobes (on being struck at the apex with a pencil for example) can be heard several yards away (fig. 1, Pl. XI.).

This explosive action of the corolla-lobes throws light on the meaning of the slits (fig. 11, Pl. X., &c.) which in various species appear at the lobes' bases. These are

* Darwin, 'Cross- and Self-fertilization,' p. 429.

probably merely an expression of the growth of the inner surface of the corolla-lobes. Of course it is equally open to suggest that they serve as an indication of the ripeness of the flower-bud ; and, doubtless, the opening of the flower in such cases as *Loranthus neelgherrensis*, where the slits between the lobes are very marked, is often, if not generally, effected by the withdrawal of a beak which has been thrust through one of these wide slits for the purpose of obtaining nectar, and which beak, in withdrawal, strikes the upper parts of the lobes as yet united but ready to separate (fig. 1 *c*, Pl. X.). The growth of the inner surface of the lobes, after their apices are freed, is coterminous with the growth of the inner surface of the upper part of the tube, which, consequently, opens out—this opening out being possible owing to the existence of the slit in the upper part of the tube.

Whether opening of ripe flower-buds without a tapping on the apex occurs, I cannot assert; although various observations seem to show that, at all events, many buds, unless tapped, remain closed.

Thus, unopened corollas which have become detached at the base of the tube, and slipped down the style, are commonly to be seen hanging on this persistent style. In such cases there is some chance of self-fertilization, as has been suggested for other genera. The inaccessibility of the flowers rendered experiment difficult; but the following was tried, with a view to determining the question of the opening or non-opening of the untouched flower-bud. Twelve apparently fully-developed flower-buds of *L. loniceroides* (on a Peach-tree) were covered by fine muslin. At the end of three weeks the results were :—

Unopened.	Opened.	Unopened and dropped.	Opened and dropped.
4	2	4	2

so that, though the numbers are too small to admit of generalizing, it may be pointed out that two-thirds of the flower-buds did not open—and that the sources of error, such as rubbing against the netting, all favour the opening of the buds.

The first day on which explosions were observed by me was bright and sunny, and it was subsequently noted that the explosions occurred with greater readiness on such occasions than on days when rain was falling. When a host-branch was cut down, the flower-buds on the *Loranthus* bush borne by it soon—in the course of less than one hour—lost their power of opening, even in response to a smart tap.

This prolonged bud state and subsequent explosion of the flowers of Loranths recalls the very similar condition of affairs which exists in species of *Crucianella*, Linn.

In addition to the "use" suggested above for this prolonged flower-bud state—viz., in procuring a closer relation between flower and fertilizer—another advantage, the protection of the pollen from rain, may be urged.

It might be supposed that in tropical flowers there is no need for protection against damp or rain effects, but the Loranthaceæ of Ceylon, probably for a reason to be referred to immediately, flower very largely in the wet season, and of the 15 Cingalese species 5 are, according to Trimen, confined to the moist low country (*L. nodiflorus*, *L. ensifolius*, *L. lonchiphyllus*, *L. Gardneri*, and *L. capitellatus*).

Many of the Cingalese species flower all the year round, and when I mention that 8 species which do so grow in the hills, and that of these hills Blanford states "the only season that can be called fine is restricted to the first 4 or 4½ months of the year, and even in these it rains on one day in 3 or 4"*, it will, I think, be conceded that a protection of pollen against rain is by no means unnecessary.

Roxburgh, in his 'Flora Indica,' and Kurz, in 'Forest Flora of British Burmah,' both distinctly mention, in describing various species, that some, e. g. *Loranthus Scurrula*, flower during the wet season, and that others flower all the year round.

Hence I conclude that this "exploding mechanism" has the highly important function of protecting the pollen from rain, and that an additional advantage is gained in that a more specialized relation between bird and flower is enforced.

The "reason" why flowering occurs during the wet months lies probably in the fact that the seeds will only germinate in moist air; at all events I have found that in moist air the hypocotyls reach their host-branch in a few days, whereas in dry air two weeks are often insufficient. Hence it may be that many *Loranthus* species have acquired the habit of flowering in the wet season in order that their seeds may germinate rapidly, and on this view the special pollen protection is of no little interest.

NOTE.—After the foregoing account of the fertilization of the flower was written, a paper by Mr. Maurice S. Evans appeared in 'Nature' (Jan. 3, 1895) dealing with the fertilization of the flowers of *L. Kraussianus*, Meissn., and *L. Dregei*, Eckl. & Zeyh., parasitic Loranths of S. Africa (Natal). My results, on the whole, confirm those of Mr. Evans. He describes the "explosive mechanism" and its absolute dependence on the blows of bird visitors (in Natal the visitor is a sun-bird, *Cinnyris olivaceus*). In one important point do our accounts differ. Mr. Evans finds that the anthers are *emptied of pollen by the explosion*, whereas my conclusion, as above stated, is that though pollen is jerked out, some is left "for future use." Mr. Evans's observation on *L. Dregei* tends to confirm his view, for in that species the anthers are (by the explosion) "broken sharp off and fly off into space with great violence, parting with their pollen as they go" ('Nature,' vol. li. no. 1314, p. 236).

II.—MODE OF DISTRIBUTION OF THE SEEDS.

I propose in this section to give a short account of the way in which the seeds of some members of the Loranthaceæ are dispersed. Engler and Prantl thus summarize what is known of the distribution :—"The stickiness (of the viscin) enables some seeds, falling from branch to branch, to become attached; on the other hand, birds bite up the fruits and throw away the seed which is surrounded by the viscid layer"†. The same authorities further state that seeds often pass unharmed through the gut of birds and may then germinate.

It may at once be stated that my investigations confirm much of what has just been

* Blanford, 'The Climate and Weather of India, Ceylon, and Burmah.'

† Engler and Prantl, 'Die natürlichen Pflanzenfamilien,' Teil iii.

quoted, and show that the excellent account given by Pitra * of the distribution of seeds of *Viscum album*, Linn., might also do duty for the Loranths; but as it is doubtful whether there is on record an account of observations on the seed-distribution of tropical Loranthaceæ, I venture to describe those made by myself. I feel further justification for so doing, inasmuch as the following passage finds a place in the English edition of Kerner's 'Pflanzenleben':—

"The dissemination of the European Mistletoe is effected, as in all the other Loranthaceæ, through the agency of birds—thrushes in particular—which feed upon the berries and deposit the undigested seeds with their excrement upon the branches of trees . . . it is, however, true that the mature mistletoe-seeds are dispersed exclusively by birds in the manner above mentioned." †

The berry-like fruits of these Loranths are, technically speaking, indehiscent; yet, owing partly to growth of the embryo, partly to the weakening of the fruit-wall, in some species, this latter becomes ruptured on the ripening of the fruits, e. g. *Loranthus neelgherrensis*, *L. cuneatus*; in others a very slight pressure is sufficient to cause the complete extrusion of the seed, sometimes basally, sometimes apically. In almost all cases the seed slips out, but in *Viscum orientale*, Willd., a gentle pressure causes the fruit-wall to crack and the seed to be jerked out. A glance at the figures (*e. g.* fig. 1, Pl. X., fig. 12, Pl. X., fig. 6, Pl. XI.) in the accompanying Plates shows that the fruits of Cingalese Loranthaceæ are comparatively large—often 2 cm. in length.

On the other hand, the two birds which in Ceylon chiefly feed on the *Loranthus* fruits are very small: one, *Dicæum minimum*=*Dicæum erythrorhynchum* (Legge), is the smallest bird in Ceylon; the other is *Pachyglossa vincens* (Legge)=*Prionochilus vincens* (Murray), a flower-pecker peculiar to Ceylon. Of these, the former has, on account of its assiduity in visiting *Loranthus* fruits, earned for itself in Ceylon the name of the 'Parasite-bird.'

The smallness of the bird and the largeness of the fruit may together constitute the main reason why the bird has adopted—as will be shown—the habit of squeezing the seed out of the fruit and rejecting the fruit-coat. The large quantity of tannin which this fruit-coat contains may also have operated to produce this result. That the above-mentioned birds have acquired the habit of extracting the seeds is shown by the following observations. Under a tree, bearing a *Loranthus* bush in fruit, many empty husks are to be found, and such husks bear V-shaped marks of birds' beaks. I have also seen a bird, *Dicæum minimum*, perched on a *Loranthus* bush sucking a seed, having rejected the husk. This proceeding is doubtless a very general one with birds. The 'Paddy-bird' in Ceylon extracts the rice-grain and leaves the husk; and I have seen a Parrot "shuck" a pea-pod, extract the peas, and reject the pod.

Further, in none of the many birds I shot and dissected did the gut contain a fruit-coat, though it was generally quite distended with the pulpy matter which had been

* Adolph Pitra, "Ueber die Anheftungsweise einiger phanerogamen Parasiten an ihre Nährpflanzen," Bot. Zeit. 1861, no. 91.

† 'The Natural History of Plants,' Kerner, ed. F. W. Oliver, part 2, p. 205.

extracted from the fruit. That this habit of squeezing out the seed betokens a special love, on the part of the birds, for *Loranthus* berries seems shown by the fact that other birds, which only visit the fruit when their more usual food is scarce, have *not* acquired the habit. Thus I shot a common Bulbul (*Chloropsis Jerdoni*) in whose crop were several *whole fruits* of *L. loniceroides.* About a dozen 'Parasite-birds' were dissected; in some pulp only was found (pulp of *L. loniceroides*), in others pulp with one seed, in others pulp with as many as three seeds.

Of the seeds so obtained, some (*L. neelgherrensis*) germinated successfully; others, however, were *soft and rotten, having been quite killed by the digestive juices.*

Now, in the course of a morning a bird visits far more than three fruits; indeed, the assiduity of the bird in gorging berries is remarkable; yet three was the greatest number found. Moreover, of seeds swallowed, some are so attacked by digestive juices as to be killed; thus when, as not infrequently happens, groups of seeds of *Loranthus* and *Viscum* species are found mixed with birds' excrement, most are completely rotten.

Hence probably the birds seek the large fruits of such *Loranthus* species as *L. longiflorus, L. loniceroides, L. neelgherrensis, L. capitellatus,* &c., primarily for the pulp formed from the middle layer of the fruit-coat; but occasionally the birds in their greed swallow the seeds; and of these, some are digested to an extent to render them unfit for germination, while possibly others pass through the gut uninjured. If a reason other than that of the large size of many of the Ceylon species of *Loranthus* be sought to account for the fact that the birds generally avoid swallowing the seeds, it may perhaps be found in this,—that the endosperm and embryo of such seeds as those of *L. neelgherrensis, L. loniceroides,* and *L. longiflorus,* and probably of many others, are exceedingly rich in tannin. A curious observation confirms the view to which the above remarks point—viz., that the birds get rid of the seeds by wiping or striking their bills against branches or other convenient objects. At the Hill-Garden of Hakgala (5500 ft.) *Loranthi* grow luxuriantly. On the single telegraph-wire there are every year hundreds of seedlings of *L. loniceroides,* all in early stages of germination. It can hardly be supposed that the seeds arrive at this anomalous position as a consequence of being voided, but rather that the birds free their beaks of them by striking or rubbing against the wire.

If due weight be given to the above-enumerated considerations and observations, it will, I think, be conceded that, at least in the majority of cases, the seeds of the large species of *Loranthus* reach their hosts without having passed through the alimentary canals of birds, and that their distribution is associated with an acquired habit on the part of the birds. This acquired habit consists in the birds first extracting the seed from the fruit-covering, and secondly, rejecting the seed and fruit-wall, both of which are rich in tannin, the bird's object being to obtain the sweetish pulp (which contains a little, but only a little tannin); and thirdly, in the wiping-off of the seeds which stick to the bill on a convenient place, usually a branch.

The alternative mode of distribution mentioned by Engler and Prantl *, whereby the seed, shaken out from the fruit as it falls, sticks to any opposed object, is, I believe,

* 'Natürl. Pflanzenfam.,' Teil iii.

of such rare occurrence as to be negligible, although the seeds are frequently *dropped by birds*, feeding on a branch, on the ground beneath. This is well shown in *Loranthus Gardneri* seeds which I found germinating with stamens of this species adhering to the viscin.

Matters are more difficult with regard to, and I can speak with less certainty of, the course of events in small seeds such as those of species of *Viscum*, e. g. *Viscum orientale*, and of *Notothixos floccosus*, Oliver. The difficulty lies in the fact that the viscid layer surrounding the seed is less developed, and therefore even less a means of protection from digestive juices in these cases than in the large-seeded Loranths. Moreover, I have frequently found, as above stated, groups of seeds of such small-seeded Loranths as *L. Hookerianus* in the voided excrement of birds on leaves or twigs. Such voided seeds are often quite hollow, proving that the intestinal juices of the birds play havoc with these tender seeds.

It is then at least highly probable that birds distribute these smaller seeds also by wiping them off their bills, and that they do so to avoid the tannin. *Viscum orientale* presents a difficulty, in that, as already mentioned, a gentle pressure suffices to jerk the small seed several feet into the air; if this be of general occurrence, the risk of not falling in "good ground," which is so successfully avoided in other species, is in this case run.

III.—Germination.

In this section the modes of germination of various species of *Loranthus* and *Viscum* are described. The order in which the members of the Loranthaceæ are here taken is determined by the degree of resemblance the germination bears to that of *Viscum album*.

Viscum orientale.—The form of fruit and seed will be described in the Appendix. Figs. 9 *b*, *c*, Pl. X., show the hypocotyl with its free swollen head growing from the apical end of the seed. The hypocotyl is rich in chlorophyll and reaches a length of 3 to 4 mm. Viscin is confined to the base of the seed; hence this latter normally lies prone on the branch, and so the hypocotyl had but a little distance to bend before reaching the branch. The whole seedling when the hypocotyl is fully grown is some 6 to 7 mm. in length and resembles a minute cricket-bat—the hypocotyl representing the handle. The seed, as is the case with all the Viscums and Loranths here described, is ready to germinate as soon as the fruit is ripe.

Notothixos floccosus, Oliver.—Fig. 10 *c*, Pl. X., shows a specimen germinating; hypocotyl bright green; free end *not* swollen into a head, but forming a somewhat convex whitish surface. As in *Viscum album* &c., and *Loranthus* species generally, the end of the hypocotyl rapidly swells to a disc before any considerable entry has been made into the host.

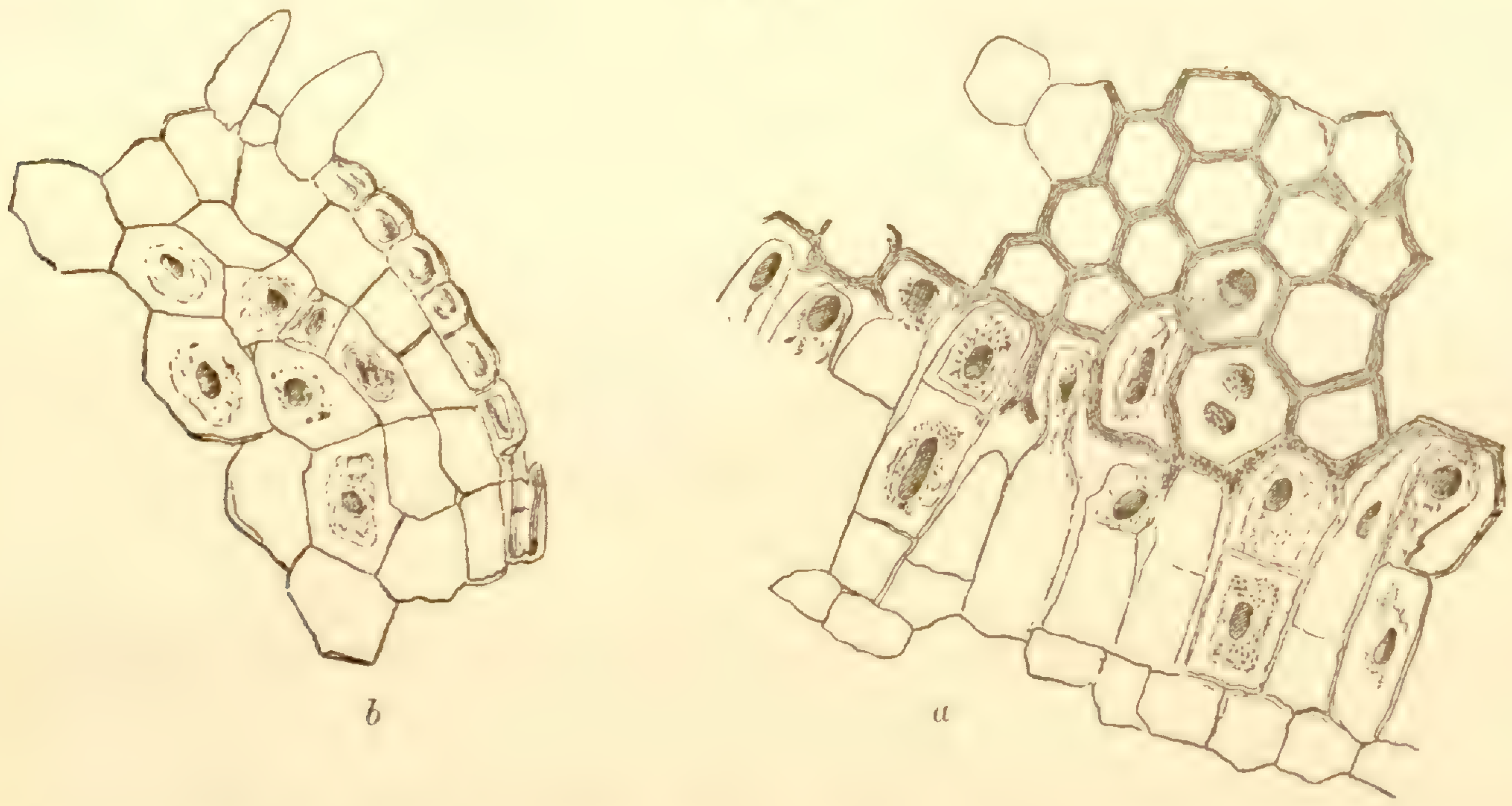
The growth of the hypocotyl is stopped in dry air. The species is peculiar to Ceylon and only found in the moist low country. The slightly biconvex, lens-shaped seed always lies flatly on the branch, so that but little curvature of the hypocotyl occurs.

L. Hookerianus, Wight & Arn.—The seed is very minute, 3–4 mm. On germinating,

the hypocotyl does not grow out, but swells and *shows no sign of curvature.* Attachment to the host nevertheless occurs, the "root-structure" growing out from the shaded side at the point of contact with the host. I grew a number of such seedlings on bottle-cork and preserved them in spirit, in order, subsequently, to ascertain by sections whether any slight curvature, imperceptible to the eye, does occur. If not, the conclusion must be adopted that in this form the smallness of the seed and the confinement of the viscin to the hypocotyl-end of the seed enables this hypocotyl to dispense with any negatively heliotropic curvature.

Loranthus loniceroides.—A ripe seed removed from its fruit-coat begins at once to germinate. A resinous drop appears at the apex—being pushed out by the head of the hypocotyl. Then the hypocotyl itself appears; its general surface, even whilst within the endosperm, is bright green, owing to the presence of chlorophyll; but the free distal surface of its head is whitish, except for a central reddish point and for a green rim (fig. 5 *c*, Pl. XI.). The whole surface of the hypocotyl is sticky.

Fig. 2.



The cotyledons are yellowish, linear, and not fused. The outgrowing hypocotyl is at first straight, but soon curves (figs. 5 *a–c*, Pl. XI.).

The seed is usually found disposed more or less vertically, apex upward, on a branch, so that the hypocotyl, by its curvature, brings its free end or 'suctorial disc' on to the host.

The disc, on coming into contact with a branch, swells considerably, and the cells of its distal surface grow out and enter the host as papillæ (fig. 6 *f*, Pl. XI., and woodcut 2, which represents a vertical section through the hypocotyledonary disc of a seedling of *L. loniceroides* grown on bottle-cork).

The seedling thus arrives at the position indicated in fig. 6 *d*, Pl. XI. The growth of the hypocotyl now becomes greatest on its concave side, and, since the sucker is firmly attached, the viscin, which holds the base of the seed to the branch, is torn away and the seed carried upward. By this growth the axis of the hypocotyl becomes once more a straight line, and the seed is borne in a line with this axis.

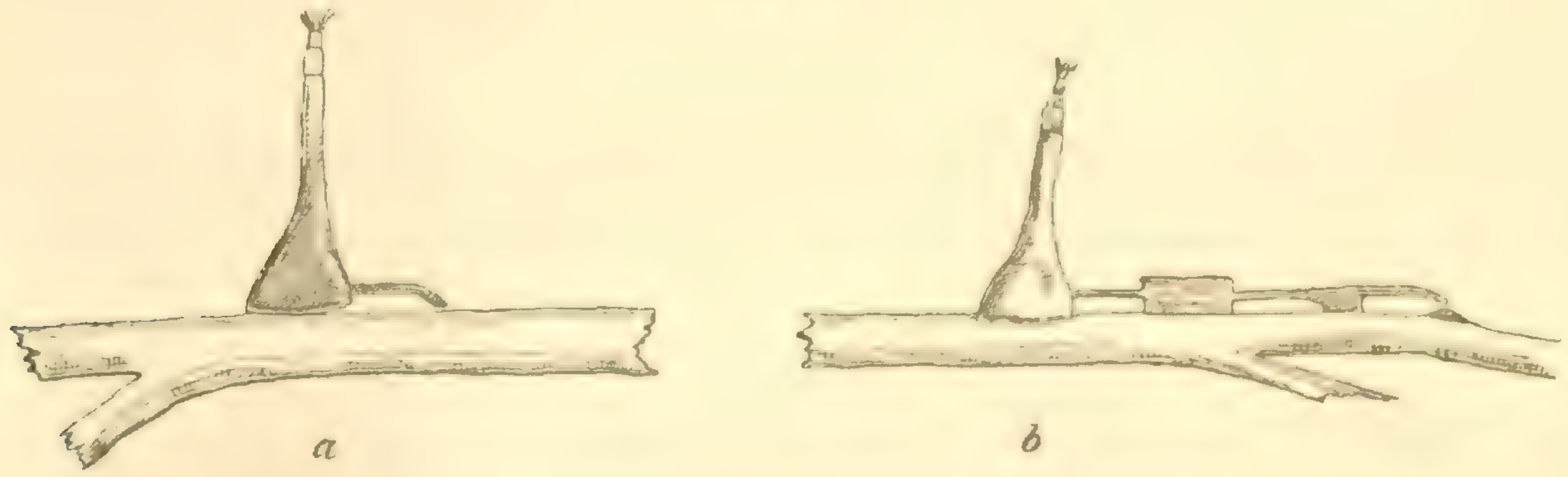
This straightening of the hypocotyl occurs even when the seed, after its hypocotyl has become fixed on the branch, is placed in the dark.

Just before or just after the hypocotyl has straightened itself, the cotyledons, together with the endosperm enclosing them, are shed and the minute plumule exposed for the first time (fig. 6 *e*, Pl. XI.); at other times the cotyledons come out of the endosperm and remain for some time enclosing the plumule.

At this stage the young plant is 2–3 cm. long, and dark green. Its sucker has swollen to two or three times its original size (fig. 6 *f*, Pl. XI.)—so much so as to suggest that it acts as a temporary storehouse of material transferred from the endosperm, *viâ* the cotyledons, before both these are, as just described, cut off.

At this stage the sucker, although firmly adherent to the bark, has effected but little penetration into the tissue of its host.

Fig. 3.



The first pair of leaves remain rudimentary and are soon shed; the plumule forms a very short internode (1–2 mm.) from which another pair of minute deciduous leaves arise; later as many as four or five very short internodes may be formed (woodcut 3), each bearing small deciduous leaves, very rich in tannin. In most species shoot-differentiation takes place very slowly, owing doubtless to the great task of penetrating the host with which the entering "root" is confronted, a task of vital and immediate importance. After penetration is effected, the growth becomes very rapid indeed; large leaves, resembling in shape those of the mature plant, arise, the internodes lengthen, and the stem throws out branches.

It often happens, however, especially when the branch on which the seed is fixed is small or poorly nourished, that, before the large leaves arise, whilst the internodes are very short, a lateral aerial root is thrown out from the sucker, and this root grows rapidly along the branch—soon seeking the underside. In extreme cases, quite large suckers may arise on this aerial root before the mature leaves are formed.

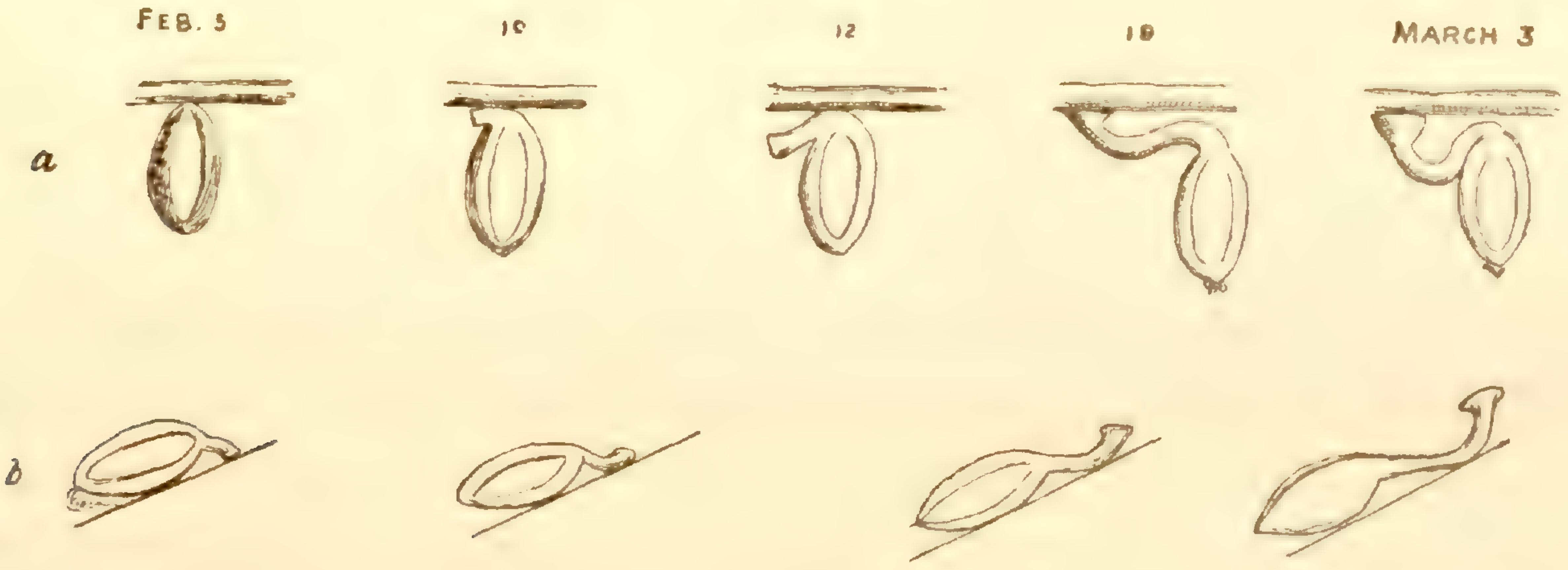
I cannot but think that this early putting out of the aerial root is a phenomenon of heredity, and throws light on the course by which the Loranthaceæ become parasites: the seeds, originally sticky, often lodged on trees, and, as in many species of *Ficus*, these seeds, germinating, threw out roots which rapidly reached the ground or the earth which collects in the forks of trees. To enable the plant to exist in this early non-parasitic stage the base (free end) of the sucker came to function as a reserve food store. From this stage the natural semi-parasitism was reached by the ability of certain cells of the distal

end of the hypocotyl to penetrate the host. Be this as it may, the character of producing aerial roots at an early stage is often of great use to seedling *Loranthus loniceroides* developing on unpropitious branches, since the aerial roots, rapidly elongating and sending out suckers at intervals, are guided by negative heliotropism to the older part of the tree, and so stand a good chance of happening upon better nourished branches.

Some interesting cases in which the seed was not so normally and conveniently placed are given in woodcut 4 *a*, *b*. It may here be mentioned that unattached hypocotyls become irregularly curved, and the heads, instead of becoming funnel-shaped, send out from their distal surface irregular white projections.

Loranthus capitellatus.—Thwaites suggested that this is probably only a variety of *L. loniceroides*. Sir J. D. Hooker * supports this view. The fruit differs in some respects from that of *L. loniceroides* (*cf.* fig. 11, Pl. XI., and fig. 4, Pl. XI.) ; but if the seed and mode of germination may be used as evidence, there can be little doubt that Thwaites's view is correct. The germinating seeds of these two species are so alike that it is almost impossible to distinguish them (*cf.* fig. 12, Pl. XI., with fig. 6 *d*, Pl. XI.).

Fig. 4.



L. Gardneri resembles *L. Hookerianus* in that it does not throw out a hypocotyl. The viscin is mainly attached to the head end (hypocotyl), and so this, and this end only, is firmly fixed to the host—hence the need for a long hypocotyl is avoided (fig. 7, Pl. X.). Fig. 8, Pl. X., shows a seedling germinating on a leaf of wild Durian—interesting, inasmuch as in this unfavourable position a very long aerial root has been thrown out and is growing along the surface of the leaf.

L. neelgherrensis.—On germinating, the seed, which becomes firmly attached by its viscid layer (especially towards its base), rapidly protrudes its minutely lobulated hypocotyl, which at once curves (fig. 2, Pl. X.). There is in this species no distinct terminal suctorial disc, though, in the rounded free end, the green colour is replaced by white, marking the place whence the " root " will issue.

As in other tropical Loranths, the seed commences to germinate directly the fruit is ripe, and the hypocotyl often bursts through the apex of the fruit-coat, *e. g.* figs. 3 and 4, Pl. X.

If the free end of the hypocotyl soon comes in contact with a branch, this end

* Hooker, Fl. Brit. India, vol. v. p. 221.

gradually enlarges, and at the same time the root quickly penetrates the host. Whether attachment be thus made or not, two small linear ovate leaves (figs. 5 and 6, Pl. X.), rich in chlorophyll, arise, appearing beside the slit which represents a gap in the fusion of the cotyledons, and through which the epicotyl, at a later stage, appears (fig. 4, Pl. X.). Even in seedlings whose "roots" have not penetrated a host, these green leaves show starch-formation, and possibly this explains the fact that these seedlings are capable of enduring for 4 or more weeks, although the root has not entered a host. Another factor which contributes to this power of endurance is the appearance of a beautifully transparent resin on the general surface of the endosperm (from the ultimate breaking down of the viscin layer), and especially covering (fig. 5, Pl. X.) the white, 2 mm. long root, which grows out from the free end of the hypocotyl.

After contact with the host is made, a foot-like structure, brown in colour, arises between the green hypocotyl and the host. This may perhaps be regarded as equivalent to the suctorial disc or swollen head of the hypocotyl of such species as *Loranthus loniceroides*. As maturity approaches, this foot increases in thickness, and so too does the green part of the hypocotyl; the plumule, on the other hand, remains for a long time very short (a characteristic of almost all the Cingalese species). Thus a plant a month old consists of a swollen foot which has grown in all directions more than the hypocotyl, and a very short plumule, which bears two or three or even more leaves. Later, the plumule elongates rapidly.

L. longiflorus.—On germination, the short hypocotyl becomes rapidly and sharply bent just below its discoidal head; the cotyledons, as in *L. neelgherrensis*, *L. loniceroides*, and other species, remain in the endosperm and are not usually withdrawn from it. From the free surface of the olive-green head the "root-structure" begins soon, whether the disc is attached to an appropriate host or not, to grow out as a small brownish projection (figs. 15 *a*, *b*, *c*, Pl. X.), and often before this root has pierced the host's tissue leaves appear issuing from the slit already referred to. It is noteworthy that these leaves are acicular, very unlike the "orbicular oblong elliptic or linear obtuse" * leaves of the mature plant, which mature leaves the same authority also notes to be "infinitely variable in shape." The discoidal head of the hypocotyl bears at its edge cilia-like projections, which, like the rest of the head, are of a dark colour.

In conclusion, Griffith †, in his classical papers on the Loranthaceæ, mentions that in *L. Scurrula*, as the fruit ripens, the "viscin" disappears; this is not altogether typical. Thus, in *L. neelgherrensis* and *L. cuneatus*, the ripening of the fruit is accompanied by a change in, not an absorption of, the viscin. In these species the very resinous viscin of the unripe seed gives place to a more watery, but still very sticky, gum-like substance, which has the property of "setting" on exposure to the air. In other species, e g. *L. Hookerianus*, *L. Gardneri*, in the ripe fruits, the viscin persists, and is extremely sticky in the region of the head of the hypocotyl.

* Hooker, Fl. Brit. India, vol. v. p. 215.

† Griffith, "The Development of the Ovule of *Loranthus* and *Viscum*," Trans. Linn. Soc. vol. xviii. part i.

IV.—The Curvature and Growth of the Hypocotyl of various Species of Loranths.

Since the time of Dutrochet it has been known that the hypocotyl of *Viscum album* is negatively heliotropic *. De Candolle sums up the case thus:—

"If germinating seeds of *Viscum album* be placed inside a room close to the window, the hypocotyls direct themselves horizontally away from the window; if they be placed just outside the window, the hypocotyls turn to the glass as if to pierce it, in making for the dark" †. Duhamel ‡ also long ago proved that "gravity" has no directive influence on the hypocotyl of *Viscum album.*

Wiesner has somewhat recently shown that the seedlings of *Viscum album* will not grow in constant darkness, light being necessary for their phototonic condition §. This fact was verified by Guérin in 1892 ||.

I may say at once that, although it was almost superfluous, the absence of geotropism and the existence of negative heliotropism were confirmed by me in the hypocotyls of two species of *Loranthus,*—*L. loniceroides* and *L. neelgherrensis.* In the cases of *L. cuneatus*, *L. longiflorus*, *L. capitellatus*, and *Notothixos floccosus* also, observations made on the direction of curvature during germination experiments showed that geotropism plays no part, and negative heliotropism a very great part, in effecting the curvature of the growing hypocotyl.

So far, the analogy with *Viscum* is complete; but with respect to growth in the dark there is a striking difference. I find that the members of the genus *Loranthus* differ among themselves, and from *Viscum,* in this respect.

Ripe seeds of *L. loniceroides* and *L. neelgherrensis* were stuck on the branches of a species of *Limonia* growing in a pot, which was then placed in a dark room. At the end of two weeks the plants were examined, and gave results from which the following conclusions are drawn:—

Loranthus loniceroides stands midway between *Viscum album* and other species of *Loranthus.* The hypocotyls of this species grow in the dark, but very slowly, compared with similar hypocotyls exposed to the light.

In *L. neelgherrensis,* the growth and curvature of the hypocotyl in the dark is great; indeed, in one case, to be discussed in another connection later, the growth was sufficient to bring the head of the hypocotyl in contact with the branch on which it was stuck, and enable the "primary root" to grow from the hypocotyl into the host in the form, as microscopic examination showed, of a wedge-shaped mass of cells.

This is not surprising, so far as the outgrowth of the "root" from the head of the hypocotyl is concerned, for, as I shall show, darkness seems to favour this outgrowth. The surprising part of the affair is the ability—in the absence of light—of the hypo-

* Dutrochet, 'Recherches anatomiques,' 1 vol. in 8vo. Paris, 1824.

† De Candolle, 'Physiologie Végétale,' vol. iii. p. 1410.

‡ Duhamel, 'Physiologie des Arbres,' 1758, vol. ii. p. 137.

§ Wiesner, in Bot. Zeit. 1878, vol. i. p. 43.

|| Ch. Guérin, "L'Histoire naturelle du Gui," Bull. Soc. Linn. Normandie, sér. iv vol. vi. 1892.

cotyl to reach the host, since the curvature so characteristic of the hypocotyl of *Viscum* and *Loranthus* alike is generally described as due only to the directive influence of light on growth *.

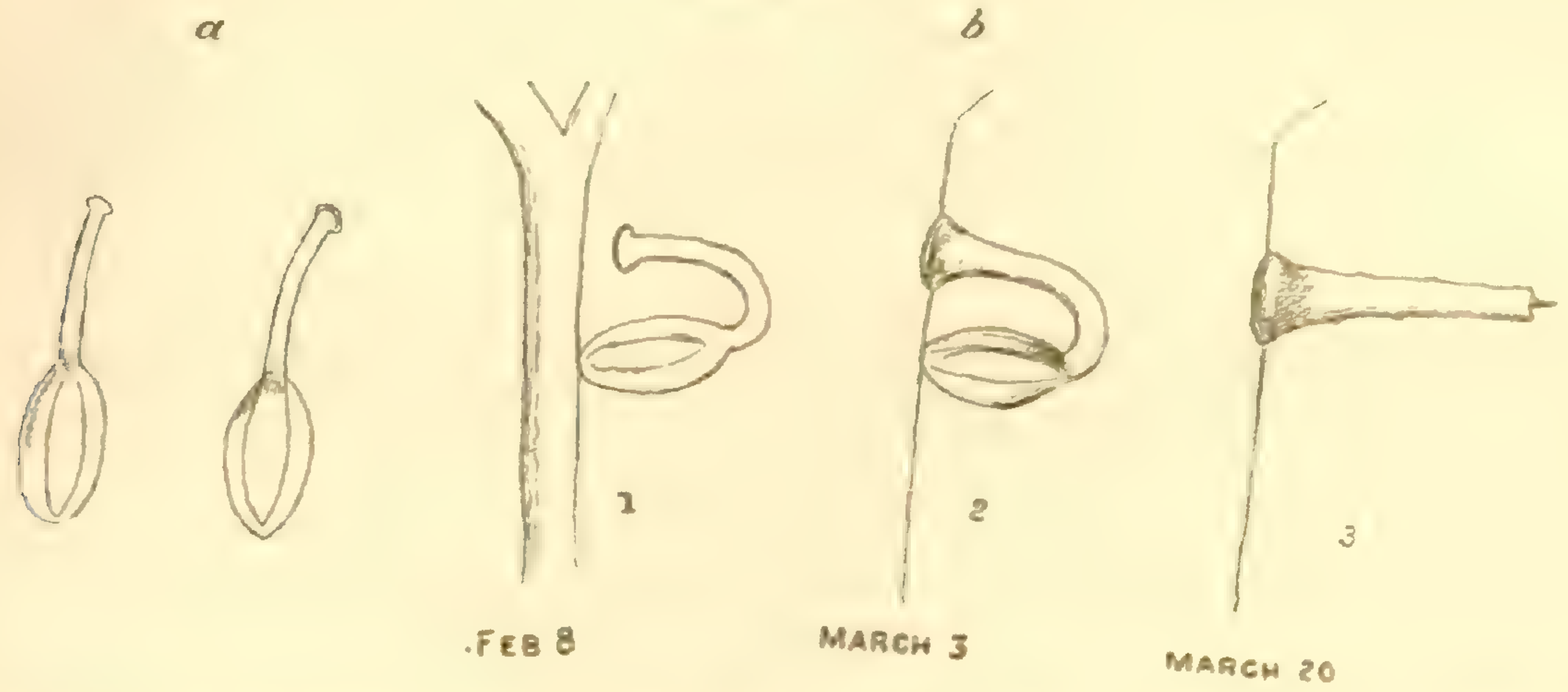
This ability of the hypocotyl of *L. neelgherrensis* to grow and curve in constant darkness was also proved by the following observation:—Ripe seeds of this species were frequently sent to me from the hills. They were picked in the morning, at once enclosed in boxes, and sent off. When any delay caused a day or two to elapse before I opened a box, it was invariably the case that many of the seeds had begun to germinate, the hypocotyl projecting (coiled up, or at least much curved) through the seed-coat, which itself, till its rupture, cut off all light from the seed (*cf.* figs. 3 and 4, Pl. X.).

It is the same with *L. cuneatus*, whose fruit, seed, and curious hypocotyl most closely resemble those of *L. neelgherrensis*. I can speak with less certainty of *L. longiflorus* (*cf.* fig. 15, Pl. XI.), although it is probable that here too the hypocotyl grows out from the endosperm and curves in the dark.

But *L. loniceroides* and *L. neelgherrensis* differ in yet another respect, in their reaction to constant darkness. In both species the hypocotyls, even whilst enclosed in the endosperm, are green, owing to the presence of chlorophyll; during growth in the dark, however, the hypocotyl of *L. loniceroides* loses its green colouring matter and becomes yellow, that of *L. neelgherrensis* remains vividly green and rich in chlorophyll.

From the point of view of evolution it would be interesting were these observations extended, for there can be scarcely a doubt that a series might be constructed connecting those Loranths which perhaps normally develop in the dark (non-parasites), e. g., *L. terrestris*, Hook. f., with those which have completely lost the power of germination

Fig. 5.



in what was originally their normal manner, viz., in the dark. The loss of this ancestral character seems to be carried far in *L. loniceroides*, to have hardly occurred in *L. neelgherrensis* or *L. cuneatus*.

A more immediate interest attaches, however, to the facts just set forth. The hypocotyl of *L. loniceroides* develops in total darkness but slowly, it is true; still, in the course of 1 or 2 weeks it reaches a length of 1 cm. or more, and *shows frequently distinct curvature*. The hypocotyl of *L. neelgherrensis* in the dark grows more and curves much more.

* *Cf.* Guérin, *loc. cit.* p. 192 *et seq.*

Further, a seedling of *Loranthus loniceroides* (showing distinct curvature of its dark-grown hypocotyl) exhibits much more curvature when, after preliminary exposure to light, it is allowed to continue its germination in a dark room (woodcut 5 *b*). Leaving aside the last statement as involving more complicated conditions, I wish to examine this curvature. *L. loniceroides* (*cf.* fig. 6, Pl. XI.) has a most convenient hypocotyl for purposes of measurement and observation of change in position, and was therefore selected for experiment.

In the first place, seeds of *L. loniceroides* were germinated opposite a window and the position of their hypocotyls noted from time to time. As the hypocotyl grew, it curved so that its head was turned from the light, but later an S-shaped curvature was set up in the hypocotyl, resulting, in some cases, in the pointing of the head of the hypocotyl toward the light (*cf.* woodcut 6). The hypocotyls of *L. loniceroides*, then, do

Fig. 6.

not curve merely in obedience to negative heliotropism: there is another factor which must be considered, viz. some kind of nutation. That nutation actually occurs was shown by adopting the method devised by Darwin * thus:—The body of a seedling was appropriately fixed, and to the head of its hypocotyl a delicate filament of glass was fastened by means of sealing-wax. This filament bore at either end a minute triangle of paper, the two triangles being so fixed that their surfaces were at right angles to the glass filament. Dots made on a vertical glass plate at points where, on looking through, the two triangles were seen to coincide, indicate the change of position of the head of the hypocotyl.

The result showed that the hypocotyl of *L. loniceroides* when growing normally is under the directive influence of light; but also that it is in a condition of nutation. Further, this nutation has influence in determining the ultimate curvature of the hypocotyl, and, consequently, the final position to which the head of the hypocotyl is brought.

The curvature of the hypocotyl in the dark was next investigated. The method described above was adopted. At each registration of the position of the triangles the seedling was necessarily exposed, though for very short times, to the light. The objection that the darkness was not absolutely continuous might be urged; but since in absolutely continuous darkness curvature of the hypocotyl has already been shown to occur, it seems to me fair to assume that the results of this examination are not vitiated by the temporary exposures during the making of the dots on the glass plate. Under

* 'Power of Movement in Plants,' Introduction, p. 6.

these circumstances also, nutation curvatures, due to the irregular growth of the hypocotyl, occur.

If reference be made to woodcut 6, it will be seen that the nutation which occurs in these hypocotyls may in some degree be likened to the "undulating" nutation described by Wiesner * and others in the case of growing "epicotyls," whereby the whole epicotyl assumes an S-shaped curvature. If the series of figures showing the development of *Loranthus loniceroides* under ordinary circumstances be examined (fig. 6, Pl. XI.), it will be seen that what indeed is normally present is exactly such an S-shaped curvature; that at first, owing to the apparently innate nutation aided by the negative heliotropism, the hypocotyl bends down toward the shaded side; but at a considerable time after the suctorial disc (the head of the hypocotyl) has become fixed to its support, the upper end of the hypocotyl (that nearest to the plumule) grows more on its concave side, and thus effects the straightening out of the whole hypocotyl, so that its axis is now a straight line. This fact has been interpreted † to indicate a "somatropic" power on the part of the hypocotyl; but it may be doubted whether the term facilitates the understanding of the process.

This nutation which occurs in *Loranthus* independent of light and of gravity has been dwelt on at some length, partly because of the general bearing the facts have on the theory of nutation, but chiefly because the view generally held that the curvature of the hypocotyl of *Loranthus* (or *Viscum*) is merely an expression of the directive influence of light (negative heliotropism) must, I think, be modified thus:—the ordinary curvature of the hypocotyls of such Loranths as *L. loniceroides* is not merely due to negative heliotropism; but is the resultant of this, together with nutation. But that this nutation is in itself highly important for the success of the parasite in any anomalous position in which it may find itself has already been practically illustrated by the account given of the *L. neelgherrensis* seedling which, though grown in the dark, succeeded by its nutation in bringing its "suctorial disc" to the host.

It not unfrequently happens that seeds of *L. loniceroides*, having been placed or dropped on a branch, topple over so that they come to lie upon the branch. The hypocotyl of such a seed grows out and bends immediately by negative heliotropism towards the branch (*cf.* woodcut 4 *a*), and its head, reaching this branch before it is more than 3 or 4 mm. in length, fails to remain there, being carried away by the elongating and nutating hypocotyl. A similar condition of affairs is brought about when the seed of *L. loniceroides* is so placed that its suctorial disc must soon come in contact with the branch (*cf.* woodcut 4 *b*).

The "force" of this nutation is sufficient to overcome the power of light combined with any influence which contact (see later) has on its "suctorial disc." This is exemplified by the behaviour of a hypocotyl of a developing *L. loniceroides* seed, so placed that the hypocotyl will grow downward on to the branch which is 3 or 4 mm. below it. Under these circumstances, as in the last case, the head of the hypocotyl,

* Sitzungsber. d. k. Akad. in Wien, lxxvii. (1878).

† Vines, 'Physiology of Plants,' p. 476.

after reaching the branch, and even pressing against it, is carried away by the nutation of the growing hypocotyl.

To briefly sum up:—Though it is perfectly true that the hypocotyls of such members of the genus *Loranthus* as *L. loniceroides* are, as has already been proved by others to be the case with *Viscum album*, negatively heliotropic and ageotropic, yet an important means in addition to the negative heliotropism, whereby the curvature of the hypocotyl is brought about, is the nutation which occurs in these hypocotyls. By this nutation the "suctorial disc" may be brought, from the position into which negative heliotropism brings it, to point directly toward the light. If no branch or object of attachment is available, the hypocotyl may ultimately become coiled up very like some tendril which has not met with a support. By this nutation the "suctorial disc," if it fails to reach the host by the direction which negative heliotropism impresses upon it, is brought into a series of positions whereby its chances of obtaining some hold on a suitable object are enhanced.

It may be remarked, in conclusion, that these hypocotyls are apparently possessed of more bilaterality of structure than those of ordinary seedlings, and, indeed, it is by no means uncommon to find the axis of the embryo obviously curved. Now Sachs has long ago pointed out "that seedlings of Dicotyledons are remarkable illustrations of bilateral structures which nutate in one plane" *, so that it may be that the more irregular nutation which occurs in the Loranths, above mentioned, is associated with the greater structural irregularity of their hypocotyls.

Growth of Hypocotyl.—On the germination of the embryo of *L. loniceroides*, the head of its hypocotyl is pushed out from the endosperm by growth in a region just behind this head; later growth is greatest in the most recently emerged zone.

At a later stage, when the hypocotyl has reached a length of about 1 cm., an intercalary region occurs in which the rate of growth is higher than in zones on either of its sides. A third and smallest maximum of growth connected with the increase of the sucker occurs at the distal end of this latter organ.

The growth of the head (suctorial disc) is, as will be shown in the anatomical section of the paper which is to follow this, connected with the later development of the main (penetrating) root, a development which proceeds to some extent when the head is growing free and not in contact either with a branch or even with an inert body. This growth is especially marked in *L. neelgherrensis*, and has been mentioned in the description of the germination of this species.

To these observations on the growth of the sucker may be added some on the enlargement of the head (suctorial disc).

Under ordinary circumstances the head of the hypocotyl of *L. loniceroides*, on reaching the host, swells considerably, becoming conical (fig. 6, Pl. XI.), with its broad base firmly affixed to the branch. When, however, the seedling is so placed that the head of the hypocotyl is free, this swelling does not take place; but the originally flat surface of the suctorial disc becomes first regularly convex, and then a number of irregular projections appear on its surface.

* Sachs, 'Text-book of Botany,' p. 857; English translation, 2nd edition.

In the dark, where, as has been mentioned, the rate of growth of the hypocotyl of *Loranthus loniceroides* is much less than in light, the head does not assume a conical form, but, by the outgrowth of its originally flat distal surface, becomes almost spherical, or the white projection may grow out beyond the general surface of the disc. In *L. neelgherrensis* a similar white projection from the free end of the hypocotyl often, even when the latter is free and the seedling is grown in the light, reaches a length of several millimetres. In this species such an outgrowth, about 2 mm. in length, pointed in one case vertically upward, thus seeming not only to be ageotropic, but also to have no reactivity to light, since after the outgrowth had commenced the seedling was removed from the dark and so placed that it received light from one side only.

The interest of the question lies in the fact that the aerial roots which develop later are in a high degree negatively heliotropic, turning back on themselves on reaching the free ends of branches along which they grow, and generally seeking the under-sides of these branches.

V.—Effect of Contact on the Hypocotyl and on its Suctorial Disc.

In the preceding section the relative influences of nutation and negative heliotropism on the ultimate position of the hypocotyl were discussed.

I endeavoured further to ascertain what other irritabilities the hypocotyl possessed—whether contact or pressure produced any curvature-movement. I found that the general surface of the hypocotyl was not irritable to contact: that when, for example, threads bearing small weights were hung over the hypocotyl no effect or curvature was produced. Hypocotyls of *L. loniceroides* growing in the dark, in which the curvature was slight, were also tested by means of these threads, and they also showed no contact-curvature.

I next sought to ascertain whether the suctorial disc (head of sucker) was affected by contact after the manner of roots*. Small squares of various objects, such as paper, sand-paper, and bark, were affixed by pressing them gently but firmly into the resin-drop which covers the head of the sucker, so that they stuck on obliquely. In no case did any curvature result, so that neither the edge of the hypocotyl nor its general surface responds by curvature to contact.

Nevertheless the minute pieces of paper, etc., do produce an effect on the growth of the free surface (root-surface) of the sucker. Repeatedly, as the result of the contact-stimulus set up by these small objects, the "root-end" of the hypocotyl, *i. e.* the free distal surface, grew out not symmetrically, but in the region of the affixed body. In other words, contact has an influence in bringing about the development of the projections similar to those referred to in the preceding section. This was corroborated in several ways.

Firstly, on four or five occasions small flies were observed to be caught on the viscid drop of resin (which covers the distal surface of the suctorial disc). These flies died and gradually turned brown, and irregular projections of the free surface grew out in their direction.

* *Cf.* Darwin, 'Power of Movement in Plants,' p. 125, etc.

Secondly, experiments were made thus :—after the hypocotyl had almost reached its full length, the seedling *Loranthus loniceroides* was so placed that the free end of the suctorial disc came in contact obliquely with tinfoil. The root-end grew out in the direction of the foil and in that region only, as is shown in fig. 9, Pl. XI. The suctorial disc, then, possesses contact-irritability, in consequence of which the "root-end" grows out toward the touching body.

In yet another case this contact-irritability was demonstrated by an experiment primarily devised to determine whether contact played a part in calling forth the rapid swelling of the conical head of the hypocotyl which takes place when it reaches a branch. A piece of glass cover-slip was pushed flatly on to the free surface of the suctorial disc. The natural resin held it in its place. On looking through the glass the outline of the disc could be seen, and marks were made on the glass coinciding with the limits of the disc.

After seven days the sucker's edge still coincided with these marks, showing thereby that contact with an inert body had not caused a swelling of the sucker ; but during this time a white "root" had grown out and projected about 2 mm. beyond the rim of the suctorial disc. Now the head of a hypocotyl which has reached a branch "swells" very rapidly indeed in the course even of one or two days. Whereas, then, the head increases rapidly when its host is propitious, *i. e.* when it can penetrate the host, no such increase occurs when the head is pressing even vigorously against an inert body. It seems possible, therefore, to distinguish between the swelling of the head, which occurs only when the sucker reaches a host into which it can penetrate, and the outgrowth of the root, which is brought about (at least to some extent) by contact pure and simple.

In order to examine early stages of penetration into the host, seedlings were grown on bottle-cork. In these cases entry was effected (woodcut 2), and the hypocotyls swelled considerably. When, therefore, the *head* of the hypocotyl comes in contact with any body, a contact-effect is produced, by which the root-end of the head grows out—not necessarily swelling—and its superficial papillate cells press firmly against the opposing body. If, however, the opposing surface is impenetrable—tinfoil, glass, etc.,—these papillate cells cannot penetrate, but continue to pour out large quantities of a semi-watery resin. If the host is a branch or piece of bottle-cork, the suctorial disc swells and the papillate cells effect an entry, apparently each of them for itself, into the cells of the host, and instead of continuing to be merely or mainly secretors of resin they become richly protoplasmic. They differ, moreover, in form : those growing into the bark or cork become cylindrical, with rounded ends (woodcut 2) ; those growing freely are much longer and more irregular in outline, and have richly granulated cell-contents.

I would suggest, therefore, that so far as these papillate cells are concerned, their entry is partly a matter of pressure, for the outgrowing root-end of the sucker does produce pressure sufficient to indent a fairly resistant surface, and, as I observed in another case, to actually split the surface of the bark of a branch into which the root

subsequently entered. In addition to this entry by pressure, woodcut 2, already referred to, shows, I think, quite clearly that each cell penetrates a cork-cell, and that the cell-wall through which it has to pass completely disappears, and is not merely pushed inward and ultimately ruptured. In this method of penetration partly by pressure, partly by solution, these surface-cells of the sucker present a close parallel with those of the haustoria of *Cuscuta*, Tourn.*.

Returning to the question from which this discussion arose, contact has been shown to influence the outgrowth of the "root-end" of the head of the hypocotyl, and probably also the growth and nature of the papillate cells of the head; but, on the other hand, the swelling of the head is not promoted by mere contact—does not take place when its distal surface comes in contact with an inert body, as glass or tinfoil. It seems, therefore, that this swelling is the result of a stimulus in some way due to the penetration of the hairs into the host, and possibly to be likened to the later hypertrophy of the host-stem itself at the place where the parasite sits.

Finally, with reference to the action of contact and pressure, it was found that whereas a "suctorial disc" of a rapidly elongating hypocotyl, on reaching a branch, very quickly applied itself closely to that branch, it, on reaching an inert body, such as tinfoil or glass, slid along that surface, leaving a resinous track, and sooner or later curved completely away, even though in so doing the head was brought directly toward the light. It seemed at first that this was the result of contact, and in the sense that "every stress, every strain produces an accelerating or inhibitory effect on growth"†, contact, clearly, does produce an effect; whether, however, the edge of the hypocotyl is sensitive to contact in the narrower sense in which root-tips and tendrils, etc., are said to be, is not decided by the mere fact that, generally speaking, when the head reaches a branch it remains there, but when it comes in contact with inert bodies it curves away. Such a view would necessitate a belief that the hypocotyl possessed some selective power in determining its host, a supposition which is unnecessary. Pfeffer has demonstrated that tendrils, which of course possess in a high degree contact-irritability, do not respond when brought into contact with wet gelatine—that this substance does not call forth contact-irritability. Pierce has recently used this method in investigating the presence or absence of contact-irritability in the stem of *Cuscuta*‡. It was applied in the case of the suctorial discs of *Loranthus loniceroides*. Seedlings were so placed that their hypocotyls were bending downward on to glass plates covered with thin gelatine, over whose surface water was continually drawn by means of strips of blotting-paper. The head soon reached the gelatine and quickly curved away. So that, using the contact-irritability of tendrils as a standard, the curvature of the head away from the surface of the gelatine shows that there is no need to suppose that the head is possessed of contact-irritability.

An examination of the various forces which may contribute to the opposite results of

* Pierce, 'Ann. of Botany,' viii. 1894, p. 55, etc.

† Pfeffer, 'Pflanzenphysiologie, Bd. ii. p. 151.

‡ Pierce, *loc. cit.* p. 65.

impact with bark and with inert bodies respectively shows, I think, that this behaviour may be explained without the help of contact-irritability on the part of the head or edge of the sucker.

There are in both cases various "forces" tending to keep the sucker in its place on the branch, and others tending to carry it away. Among the former are negative heliotropism, the resin on the free surface, rapid growth of papillæ into the host inducing swelling of the sucker especially at its edges, whereby it may be imagined to act somewhat after the fashion of a surgeon's "cup." On the other hand, tending to the removal of the head of the hypocotyl, is the nutatory growth which, acting favourably at one time, will act unfavourably at others; and the pressure-effect, whereby the hypocotyl tends to take the line of least resistance. In the case of hypocotyls attaching to the branch, the factors favouring adhesion outweigh those tending toward removal of the head; but not always, and therein lies confirmation of this view. It has already been remarked that hypocotyls whose heads come very soon in contact with a branch are carried completely away from the branch into which other heads of hypocotyls, whose curvature is more complete, are growing quite normally. In other extremes, also, the same thing occurs. Old hypocotyls which are nutating in small irregular circles may come in contact with a favourable branch, and yet, owing probably to failure of resin and hairs, be carried away by the continuation of the nutation.

This curving away from the surface is the normal course of affairs when the host is some hard inert body, such as glass or tinfoil, for the nutation tends toward removal, and fixation is not aided by an ingrowth of the surface-cells, nor by the growth of the edges of the disc (and this latter seems to have an indirect effect as well, inasmuch as the resin is not pressed well into the surface of the host and does not set firmly).

To briefly sum up this section:—absence of light tends markedly in *Loranthus loniceroides* to inhibit growth of hypocotyl, less so in such species as *L. neelgherrensis*; absence of light promotes the outgrowth of the root-end of the hypocotyl, *i. e.* root-formation.

The general surface of the hypocotyl does not respond to contact. Contact, however, favours the outgrowth of the root. The root, in growing out, exerts considerable pressure —sufficient in some cases even to split the bark of the host-branch.

The hypocotyl curves away from inert bodies, and even from its natural host when reached at unfavourable times. This curving away is not the result of contact-irritability, but represents the direction of the resultant of opposing "forces," viz., on the one side nutation and pressure-effect (line of least resistance), on the other negative heliotropism, adhesive power of resin and of ingrowing papillæ, and growth of the rim of the suctorial disc.

APPENDIX.

Forms of Fruits and Seeds of some Species of the Cingalese Loranthaceæ.

There are in Ceylon some 15 species of *Loranthus*, 6 species of *Viscum*, 1 species of *Notothixos*, and 1 species of *Ginalloa*. The species of which I give some account in this section are those which in the following list are *not* included in parentheses ( ). The list is taken from Hooker's Fl. Brit. Ind. vol. v. p. 203 *et seq.* Those species marked with an asterisk (*) are endemic.

Section I. Euloranthus	(Loranthus nodiflorus, *Thw.*)*.
,, II. Phœnicanthemum	(L. ensifolius, *Thw.*)*.
	L. Hookerianus.
,, IV. Cichlanthus	L. Scurrula.
,, V. Dendrophthoë	L. tomentosus, *Heyne.*
	L. cuneatus.
	(L. sclerophyllus, *Thw.*)*.
	L. ligulatus, *Thw.*
	L. suborbicularis *.
	L. longiflorus.
	(L. lonchiphyllus)*.
	L. neelgherrensis.
,, VI. Tolypanthus.	L. Gardneri *.
,, VII. Elytranthe	L. loniceroides.
	L. capitellatus.

Viscum (monoicum, *Roxb.*).
,, orientale, *Willd.*
,, (capitellatum, *Sm.*).
,, (ramosissimum, *Wall.*).
,, (articulatum, *Burm. f.*).
,, (japonicum, *Thunb.*).
Notothixos floccosus.
(Ginalloa spathulifolia, *Oliver*) *.

The above list is merely given as an indication of the representation of the order in Ceylon.

The following descriptions of fruit and seed may be found useful:—

Loranthus loniceroides.—Fruit "ellipsoid" †; really its elliptical body is continued above into a short tube (bases of calyx), giving it a flask-shaped appearance (fig. 4, Pl. XI.).

Fruit dark, glossy, green when ripe, rapidly turning black (as in many other species) owing to large quantity of tannin contained; bracts scarcely deciduous, though so stated in the 'Flora of British India.' Inner layers of fruit (false berry) form green pulp, slightly sweet; seed on squeezing fruit issues basally, carrying with it (fig. 5, Pl. XI.) a layer of "viscin" attached to basal end of seed. Viscin semitransparent, sticky, rapidly drying

† Hooker, 'Fl. Brit. India,' v. p. 221.

and then not swelling up again (as is stated to occur in *Viscum album**). The viscin consists of cells which have broken down to mucilage. These cells are attached to the base of the seed by a short column of stout cells which project from the base of the endosperm. Owing to the connection of the viscid layer with the pulpy part of the fruit-walls, the seed turns a somersault on issuing, and thus the apex issues first; further squeezing extracts the pulp. *Seed* 1 cm. long, green or green-brown colour (owing to thin parchment-like layer covering greenish endosperm), ellipsoid, 6-grooved.

Loranthus capitellatus.—Regarded as a variety of the former species by Thwaites and Sir J. D. Hooker: fruit differs considerably, but very variable, and in some variations approaches that of the former; but fig. 11, Pl. XI., shows well-defined colour and shape considerably different from that of *L. loniceroides.* Fruit, unripe, colour bright red; ripe, glossy green-black; tube surmounting body of fruit longer than that of *L. loniceroides*; seed very similar, but shorter and more spherical.

L. Gardneri.—'Flora of British India:' "Fruit (young) ellipsoid." I find fruit, almost sessile, unripe buffy colour, ripe red (fig. 7, Pl. X.), 8 mm. long, surmounted by narrow rim—the remains of the 5-toothed calyx; often 4 fruits in coloured bracts (fig. 6, Pl. X.), base of fruit 4–5-punctate; white seeds issue apically; viscin yellow, watery, very viscid, investing mainly the upper half of the endosperm. *Seed*: endosperm white, head of embryo protruding yellow, because enclosed by viscin; tough viscin extends considerably above head of embryo; endosperm affixed to base of fruit by a non-viscid white cup, continuous above with viscin (fig. 7 *b*, Pl. X.); this viscin prevents basal attachment of seed to host. Embryo (fig. 7 *c*, *d*, Pl. X.), head surrounded by semi-transparent viscin, yellow-green, curved in fruit; cotyledons fused, bright green, furrowed on one side; whole embryo very delicate. Endosperm (covered by some yellow viscin) white, like that of a hard-boiled egg.

L. suborbicularis has an oval fruit which, when ripe, is bright red, and its seeds are dumb-bell-shaped and green. In neither this nor in *L. tomentosus* does the hypocotyl grow to any considerable length. Their germination resembles that of *L. Gardneri,* already described.

L. neelgherrensis.—Fruit, described in Hooker's 'Flora of British India,' "oblong, half an inch: smooth"; its shape is rather obovate-ovoid (fig. 1 *a*, Pl. X.); unripe, dark green, smooth; ripe, bright orange, surmounted by remains of calyx; seed issues apically on squeezing fruit; the layer of the fruit-wall surrounding the endosperm consists in the unripe fruit of cells standing at right angles to long axis and rich in resin; as the fruit ripens this layer becomes less resinous, so that the seed on issuing is covered by a watery, somewhat sticky layer, which turns brown on exposure to air (fig. 5 *a*, Pl. X.). Seed somewhat elliptical, pointed acutely at basal end; hypocotyl and cotyledons containing much chlorophyll, green; head of hypocotyl in ripe seed projects just beyond endosperm and presents a pitted appearance, owing to its surface being covered by a great number of minute projecting lobes consisting of groups of cells containing chlorophyll and rich in tannin.

The embryo is usually not quite symmetrical within the endosperm; its cotyledons are

* Ch. Guérin, in Bull. Soc. Linn. Normandie, 1892.

of unequal size and fused except at the tips, the line of fusion being indicated on their surface by a linear depression. Hypocotyl just below head is oval in section, whilst a section through the head shows a spherical shape, though projecting all round from the surface are the small lobes. Two embryos are occasionally developed in one fruit, as is sometimes the case with *Viscum album*.

Loranthus cuneatus.—The fruit and seed closely resemble those of *L. neelgherrensis*, already described. Fruit is smaller than in that species, 1 cm. long.; shape, 'Flora of British India' says, "oblong," but rather that indicated in fig. 2, Pl. XI., dull rose-coloured at base, green above, apex irregularly lobed; seeds issue basally, enclosed chiefly toward the root-end in watery whitish viscin; seed flask-shaped, broad end basal, apical end covered with a more sticky substance in the form of five horns; seed rosy-red below, yellow above owing to the viscid covering just mentioned. On separating these viscid horns the minute head of the hypocotyl appears just projecting from the green endosperm.

The embryo is small, green; cotyledons fused.

The mode of germination so closely resembles that of *L. neelgherrensis* that no description need be given.

L. longiflorus.—Two varieties grow in Ceylon, the normal and var. *amplexifolia*. The difference is mainly one of leaves, no distinction in fruit, seed, or mode of germination, so that one description will suffice. The fruits are large, 2 cm. oblong, bright red when ripe (fig. 12, Pl. X.), green unripe; fruit-coat very thick, tough; seeds issue apically, embedded in yellow viscid matter, which takes the form apically of 5–6 viscid elastic horns (fig. 13, Pl. X.). If in an unripe seed a circular cap be cut off the fruit, as in fig. 16, Pl. X., the horns are found already formed and projecting into as many compartments of the fruit-coat. At the time of ripening these horns break down, becoming more watery; the basal surface of the seed has no sticky stuff attached to it, but presents a dry white appearance. Endosperm hard, whitish yellow; surface brown, owing to drying of viscin layer: in the ripe seed the broad head of the embryo projects from it (fig. 13, Pl. X.). The distal surface of this head is slightly convex; its outline in a plane at right angles to the main axis of the embryo is circular—that is to say, this head is lenticular. Around the edge of this lens-shaped head is a fringe of multicellular projections (fig. 15 *b*, Pl. X.). The embryo is often not quite symmetrical in the endosperm. Continuous with the head is often a thread of cells transparent viscid, the remains of the suspensor. Whole embryo bright green, chlorophyll-containing, whilst enclosed in the endosperm; the head on its escape from the latter secretes a resinous substance.

Cotyledons fused, except at junction with hypocotyl, where is a slit. Very frequently the embryo shows a curvature already noted in other species.

Viscum orientale.—The fruits of this leafy *Viscum* are small, green, somewhat lenticular, with oval outline (fig. 9 *a*, Pl. X.). When ripe, gentle pressure causes the fruit to suddenly burst, whereby the small (2–3 mm. long) seeds fly out. There is only a small quantity of viscin, and this is attached to the base of the seed. The ungerminated seeds resemble in such a remarkable degree small green *aphides* that I was able to deceive

Mr. Nock, the head gardener of the Hakgala Gardens, by placing some of the seeds on a garden plant. I do not suggest that this is a case of mimicry, but rather one of accidental, though strikingly close, resemblance. The embryo is minute; the hypocotyl has a slight swelling at its free end, and is, like the endosperm, green.

Notothixos floccosus.—Fruit "ovoid, white, one-eighth of an inch long"*; the fruit is $\frac{1}{4}$ inch long, and, when fully ripe, white and glabrous, in the almost ripe stage is buff-coloured and tomentose. The ripe fruit is remarkably like that of the ordinary Mistletoe (*Viscum album*); seed lenticular, with a small amount of viscin attached basally (fig. 10, Pl. X.).

Loranthus Hookerianus.—Flower and fruit small. Fruit 5 mm., globular, rusty red; seed issues basally. Base of seed white, non-sticky, punctate, upper half surrounded by white viscin, sticky. Endosperm green; from it the head of the embryo projects.

Embryo: hypocotyl almost globular; cotyledons small, fused.

The small seeds are often found in groups, in excrement of birds, and most, so found, dry and hard—dead; some few, however, are germinating. The same applies to other small-seeded forms of Loranthaceæ, e. g. *Notothixos floccosus.* See section on distribution of seeds.

It is noteworthy that in these small-seeded forms the greatest (or only) stickiness is at the apical end of the seed, e. g. in *Loranthus tomentosus, L. Gardneri,* etc.; whereas in the large-seeded forms, whose hypocotyls grow to a considerable length, it is the basal end of the seed which becomes firmly attached by its viscin to the host.

EXPLANATION OF THE PLATES.

Plate X.

Fig. 1. Flowers and fruit of *Loranthus neelgherrensis.* Flowers (*c*) show clefts between corolla-lobes and also the slit or throat of opened flower. *b.* Section through ripe fruit showing green embryo and white endosperm.

2. Seed of *L. neelgherrensis* germinating on Acacia leaf; green, lobulated hypocotyl, and brown layer of dried viscin covering endosperm.

3 & 4. Fruits of *L. neelgherrensis,* dark-grown (3 times nat. size), whose walls are burst by growth of embryo. In fig. 3 a white "root-structure" is growing from the free end of the hypocotyl. Fruit-coats black, owing to the large quantity of tannin they contain. Fig. 4 shows cleft whence the plumule emerges. The cotyledons, almost entirely enclosed in the endosperm, are fused except for this cleft.

5. Germinating seeds of *L. neelgherrensis.* *a.* Showing first-formed leaves and a white structure (indicated by *r* in *b*) growing from the free end of the hypocotyl.

6. *a, b.* Flower and fruits of *L. Gardneri.* *c.* Fruits enclosed in a whorl of brightly coloured bracts.

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* Hooker, Fl. Brit. India, vol. v. p. 228.

Fig. 7. Fruit and seed of *Loranthus Gardneri*. *a*. Ripe fruit (nat. size). *b*. Seeds enclosed by yellow viscin and basal white non-viscid cap. *c, d*. Seeds, nat. size; viscin completely removed. *e*. Non-viscid cap removed (at side) and also the watery viscin surrounding the body of endosperm, the yellow and much more sticky viscin around the head left. *f*. Embryo dissected out from fruit seen from side. *g*. From the side of the slit (for plumule). Note lack of symmetry of embryo whilst in the fruit.

8. Germinating seedling of *L. Gardneri* on leaf of wild Durian. Entry has been effected and a lateral root thrown out.

9. *a*. Fruits of *Viscum orientale*. *b*. Nat. size. *c*. Enlarged germinating seeds of *V. orientale*; endosperm and hypocotyl green. *d*. Seeds of *V. orientale* issuing basally from fruit-coat.

10. *a*. Ripe fruit, *Notothixos floccosus*. *b*. Seed with inner layers of fruit-coat (not viscid) at side and viscid basal thread; endosperm green. *c*. Germinating seed of ditto, free end of hypocotyl not swollen to a head.

11. *Loranthus longiflorus*. Flower; buds show slits at the bases of the corolla-lobes.

12. *L. longiflorus*. Fruits.

13. *a*. Endosperm surrounded by viscin, which is continued above into 5 or 6 horns (*cf*. fig. 16). *b*. Section through endosperm showing young embryo.

14. Section through nearly ripe fruit.

15. *a, b*. *L. longiflorus* germinating. *c*. Ditto: ventral aspect of disc of hypocotyl.

16. *L. longiflorus*, fruit. *a*. In section. *b*. Upper $\frac{1}{3}$ removed, showing viscid horns.

17. *L. longiflorus*. Young embryo, much enlarged.

Plate XI.

Fig. 1. *Loranthus tomentosus*, var. *lanuginosus*, showing the positions of the corolla-lobes, stamens, and style after explosive opening.

2. Fruits of *L. cuneatus*.

3. Flowers of same. *a–e*. Successive stages.

4. *Loranthus loniceroides*. Fruit.

5. *L. loniceroides*. *a*. Shows seeds issuing basally; to the base of the seed sticky viscin is attached. *b*. Germinating seeds, showing apex of hypocotyl, and cotyledons not fused. *c*. Apex of hypocotyl.

6. *L. loniceroides*. *d*. Successive stages of germination and attachment. *e*. Firmly attached to host; it has excised its cotyledons and endosperm, exposing the plumule. *f*. Young plant from whose swollen base a lateral root is arising.

7. *L. loniceroides* which has failed to reach a host, head not swollen, and grown out into irregular white mass.

8. Group of seeds of *Loranthus loniceroides* and *Viscum orientale* found together on a branch.

9. *L. loniceroides* grown so that the head of its hypocotyl was in contact with tinfoil. At the place of contact a projection is thrown out.

10. *L. capitellatus*. Flower.

11. *L. capitellatus*. Fruits; chocolate-red are unripe, dark greenish-black ripe.

12. *L. capitellatus*. Germinating seed (*cf*. with that of *L. loniceroides*, fig. 6 *d*, Pl. XI.).

LORANTHACEÆ OF CEYLON.

F. W. K. del.

LORANTHACEÆ OF CEYLON.

J. N. Fitch lith & imp.

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THE

TRANSACTIONS

OF

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THE DISTRIBUTION OF PLANTS ON THE SOUTH SIDE OF THE ALPS.

BY

THE LATE JOHN BALL, F.R.S., F.L.S.

WITH AN INTRODUCTORY NOTE BY W. T. THISELTON DYER, C.M.G., C.I.E., F.R.S., F.L.S.

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IV. *The Distribution of Plants on the South Side of the Alps. By the late* John Ball, *F.R.S., F.L.S. With an Introductory Note by* W. T. Thiselton Dyer, *C.M.G., C.I.E., F.R.S., F.L.S.*

Read 2nd May, 1895.

THE late Mr. John Ball, F.R.S , as is well known, devoted a considerable portion of a very varied life to the minute study, both topographical and scientific, of the European Alps. The results of the former were embodied in a book, which, in its way, will, I suppose, always remain a classic, the well-known 'Alpine Guide.' Those of the latter he never published in a comprehensive form, though he drew from time to time for occasional papers upon the records which he had patiently accumulated for a period of about thirty years.

Mr. Ball died on October 21, 1889, somewhat unexpectedly, after a brief illness. Some time afterwards his widow placed in my hands his botanical papers in the hope that I might be able to extract from them something of permanent value which would record his long and patient labours upon the Alpine flora. The task was no easy one, and I think I should have shrunk from it without the encouragement of Mr. G. C. Churchill, the best surviving authority in the country on the subject, and of Mr. J. G. Baker, F.R.S., the Keeper of the Kew Herbarium. As the result, I found that practically the whole of Mr. Ball's work on the flora of the Alps is concentrated in the elaborate Table of the Distribution of Plants on the South Side of the Alps which is now submitted to the Society.

The precise nature of the task which Mr. Ball set himself is described in a lecture "On the Origin of the Flora of the European Alps," which he delivered before the Royal Geographical Society on June 9, 1879. It will be best given in his own words:—

"More than twenty years ago I began to tabulate the plants of the Alps, so as to show the distribution of each species within the range of the Alps and on the other mountains of Europe. As the southern side of the main chain has the richest and most varied flora, and was at that time the less fully known, I divided it into fifty districts, and set myself to collect materials from published works, from public and private herbaria, and mainly from my own repeated visits—this part of my work involving, in fact, the preparation of fifty local floras. Though I regard the work of botanical exploration as yet far from complete, I in this way accumulated a great mass of materials, and the question then arose as to what conclusions should be drawn from them." (Proc. R. Geogr. Soc. 1879, p. 565.)

It will be seen that what Mr. Ball accomplished, and, so far as it is possible to judge, in a tolerably exhaustive manner, is to work out the detailed distribution of the Alpine flora for fifty easily recognizable districts on the same principle as that adopted with such

conspicuous success by Mr. H. C. Watson for the flora of Great Britain in his well-known 'Cybele Britannica.'

I learn that during the last few years of Mr. Ball's life, partly from failing eyesight, partly from other causes, he had worked but little at the Table, though he always regarded it as of great importance. I do not know that this materially diminishes its value. It is obvious that no work of the kind can ever be absolutely final.

I am indebted to Mr. C. H. Wright, Assistant in the Kew Herbarium, for the patient labour with which he has prepared the Table for the press in a form convenient to consult. Beyond this, which is a mere matter of typographical arrangement, no attempt has been made to edit it in any way.

Mr. Ball appears to have compiled it partly, as he states, from recorded, but no doubt in great measure from personal observations*. As he possessed an almost unique knowledge of Alpine plants, I can hardly doubt that the details were in every case critically sifted, and are, as recorded, thoroughly trustworthy.

There is, however, one obvious difficulty in work of this kind when data derived from different sources are made use of; this is the reduction of the observations to a uniform standard. Mr. Ball was fully aware of this. Scattered between the pages of the Table was a profusion of loose scraps of paper on which were written critical remarks relating to the various entries. These have been carefully pasted down in their proper places in the original manuscript, so as to be available for future reference. I thought at first that a selection of these notes might have been made into a brief commentary. But the task of attributing to them the particular weight which the author intended seemed all but impossible, and it may be presumed that no entry had been made in the Table itself without due deliberation.

It was also proposed to accompany the Table with a map showing the districts. This idea was abandoned, and for similar reasons. Those who are acquainted with an intricate mountainous country will readily understand that, though practically there may not be the smallest difficulty in recognizing a particular district on the spot, questions of great intricacy may and probably will present themselves in attempting to delimit it on a map.

In the passage which I have quoted from Mr. Ball, he himself raises the question "what conclusions should be drawn from" his work. And to this it must be confessed that he himself has returned no satisfactory answer, so far as the problem of the local distribution of the plants on the southern slopes of the Alps is concerned. Had his life been spared to us we might have hoped that he would have seen his way to summarize his results. At any rate, the material will now be available for anyone who has the time and inclination for an interesting task. If I may venture to express my own opinion, the best guide to the results will be found in a remarkable paper by the late M. Alphonse de Candolle, which was communicated to the International Botanical

* I take from a small note-book the following as some of the principal sources of information, besides his own observations, of which he made use:—Bertoloni, Bentham, Ambrosi, Parlatore, Rev. S. W. King, Boissier, Reuter, G. C. Churchill, Nyman, Thomas of Bex, Montini of Bossorno, Rev. Pietro Porta, Allioni, Pirona, Saussure, Cesati, Lisa, Alberto Franzoni, and Dr. Rostan.

Congress held at Florence in 1874. The title is "Sur les causes de l'inégale distribution des plantes rares sur la chaîne des Alpes." * It is worthy of notice that M. de Candolle places as a text at the head of his paper the following quotation from Mr. Ball:—"It is a matter of curious inquiry to ascertain why certain districts of the Alps possess a far more varied vegetation than others."

I must admit that the explanation offered by M. de Candolle has always seemed to me extremely probable, and indeed almost convincing. Mr. Ball, who opened the discussion, held other views which he developed subsequently in the lecture to which I have referred.

But I think it only just to point out that, however much the views of Mr. Ball and of M. de Candolle may differ in detail as to the way in which the results were brought about, there is a substantial basis of agreement in the recognition of the fact that there is an element of great antiquity in the Alpine flora which cannot be simply accounted for on the hypothesis of a migration from the north during the glacial epoch. As de Candolle shows, some of the most ancient fragments of the Alpine flora are now to be found only on the *southern* slopes of the Alps. This is the case with species of *Primula, Pedicularis*, and *Oxytropis*, which exist neither in the interior of Switzerland nor in the North of Europe. De Candolle further points out that the Alpine species of *Campanula* peculiar to Mont Cenis, the Simplon, and the neighbouring valleys, are not related to Arctic species, but to those of mountain-chains to the eastward.

Both these distinguished botanists were agreed in admitting that the glacial period must have played an important part in modifying the Alpine flora. Mr. Ball, however, was somewhat disposed to minimize its effect. To him the Alpine flora was a fact of great antiquity which the glacial period practically left unmodified. He continues:—

"I could name a few plants whose present habitat on the mountains of Central Europe may probably date only from the glacial period, and there are a few others that have perhaps come in recent times from the mountains of Northern Asia; but I venture to affirm that the effects of the glacial period both on the distribution of plants and on the climate of Europe have been greatly overrated. Even during the period of maximum cold the highest ridges of the Alps were not completely covered with snow and ice; for we still see by the appearance of the surface the limit above which the ancient ice did not reach, and in the middle zone the slopes that rose above the ancient glaciers had a summer climate not very different from that which now prevails. In my opinion the effect of the glacial period on the growth of plants in the Alps was to lower the vertical height of the zones of vegetation by from one to two thousand feet." (Proc. R. Geogr. Soc. 1879, p. 584.)

De Candolle, on the other hand, thinks that a large element was driven south, and subsequently regained its footing only on the southern face.

Apart from the fact that the Table forms a minute and probably very accurate piece of botanical topography, it must, I think, be evident from these considerations that a detailed study of the distribution of plants on the southern slopes of the Alps was not

* I may refer, for those who have difficulty in consulting the original paper, to a brief abstract which I communicated to 'Nature' for April 27, 1876.

unworthy the pains which Mr. Ball bestowed upon it. It cannot fail to add a new interest to the travels of botanists in this region. Each of Mr. Ball's fifty districts will afford a suggestive problem, if tested in the light of M. de Candolle's theory.

The following extract from the lecture already quoted is important as showing the principles which Mr. Ball adopted in framing his list of species:—

"It is not . . . easy to fix the limits of the Alps on the northern and southern sides where the mountains gradually subside into the plains. On the south side especially many plants whose natural home is in the low country have spread into the valleys, and appear here and there as immigrants; while, on the other hand, numerous natives of the warmer slopes (many of them not known to grow elsewhere) do not ascend to the higher zone, but cannot be excluded from the study of the Alpine flora. I have, as a rule, omitted from my lists the plants of the plains that appear in the Alps only as occasional stragglers, but I have included all the other indigenous species, although some of them do not rise more than two or three thousand feet above the sea-level." (Proc. R. Geogr. Soc. 1879, p. 566.)

To this may be added a further passage giving the actual number of species which, according to Mr. Ball's views, should be included in the flora of the Alps:—

"I find in the whole region 2010 species, divided into 523 genera, included in 96 natural orders. But of these natural orders there are no less than 36 that are not at all represented in the higher zone, and in the lower only by a few genera and species of wide range. These 36 orders include 53 genera and 76 species—only an average of about 2 species for each order—and evidently represent groups whose natural home must be sought elsewhere. In addition to the 2010 species I reckon no less than 335 subspecies—forms closely allied to recognized species, but distinguished by differences more permanent and better marked than what are commonly called varieties. Most of these, as well as a great many which I reckon as mere varieties, are counted as separate species by many French and German botanists." (Proc. R. Geogr. Soc. 1879, pp. 567–8.)

Mr. Ball had in many cases added to the names of the species a number of letters the meaning of which for a long time baffled me. I am indebted to the acuteness of Dr. Stapf for the discovery that they were intended to indicate the zones of altitude at which the species occurred. As, however, Mr. Ball had left this feature of the Table obviously incomplete, it is omitted.

A less detailed statistical analysis of the whole flora in regard to altitudinal distribution is, however, given in the lecture already cited. I quote the following:—

"In ascending the Alps from the region of the olive, or the vine, to that of perpetual snow, we find, as you well know, a continuous change in the aspect of the vegetation, and botanists have distinguished various successive zones corresponding to these changes. For our present purpose it will be enough to take account of three well-marked divisions:—a lower zone extending up to the limit of deciduous trees, an upper zone including the higher pine forests and the Alpine pastures, and a glacial region where patches of snow remain through the summer, and only a part of the surface is cleared for two or three months, and even there sharp night-frosts frequently recur." (*L. c.* p. 567.)

"In the flora of the upper zone of the Alps I count 1117 different species, which have been arranged in 279 genera and 60 natural orders. The proportion which the natural orders bear to each other is not very different from that which they show in the general flora of the Alps. The *Compositæ* still form about one-eighth of the whole; but the Leguminous tribe, the Grasses, and the *Umbelliferæ* show a smaller percentage. The Crucifers and the *Caryophylleæ* are comparatively more numerous, as are the six tribes which I have already spoken of as especially characteristic of mountain floras *. For the glacial region I shall not attempt to give you accurate figures, for the simple reason that sufficient materials do not exist. I have long since ascertained that the real check to the extension of many species in the highest zone of the Alps is not climatal, but the want of soil and situation suitable to each plant; and where from accidental circumstances these are found, the glacial region is seen not to be so inhospitable as is commonly supposed." (Proc. R. Geogr. Soc. 1879, p. 569.)

Of the Alpine flora in general, and that of the middle or infra-glacial zone referred to above as the "Upper" (and below as "Higher"), Mr. Ball gives the following detailed analysis:—

The following are the natural orders represented in the Alpine flora; those printed in italics do not extend to the higher zone:

Ranunculaceæ.	Rosaceæ.	Gentianeæ.	*Aristolochieæ.*
Berberideæ.	Saxifrageæ.	Polemoniaceæ.	*Cupuliferæ.*
Nymphæaceæ.	Crassulaceæ.	Boragineæ.	*Corylaceæ.*
Papaveraceæ.	*Droseraceæ.*	*Convolvulaceæ.*	*Loranthaceæ.*
Cruciferæ.	Haloragеæ.	*Solanaceæ.*	Santalaceæ.
Resedaceæ.	*Lythrariæ.*	Scrophularineæ.	Coniferæ.
Cistineæ.	Onagrarieæ.	Orobancheæ.	*Gnetaceæ.*
Violarieæ.	Umbelliferæ.	Lentibularieæ.	Orchideæ.
Polygaleæ.	*Araliaceæ.*	Selagineæ.	Irideæ.
Caryophylleæ.	*Corneæ.*	Labiatæ.	Amaryllideæ.
Portulaceæ.	Caprifoliaceæ.	Plantagineæ.	*Dioscoreæ.*
Tamariscineæ.	Rubiaceæ.	Chenopodiaceæ.	*Alismaceæ.*
Malvaceæ.	Valerianeæ.	Polygonaceæ.	Juncagineæ.
Tiliaceæ.	Dipsaceæ.	Paronychieæ.	Potameæ.
Hypericineæ.	Compositæ.	Thymeleæ.	Typhaceæ.
Lineæ.	Campanulaceæ.	*Eleagneæ.*	*Aroideæ.*
Geraniaceæ.	Vaccinieæ.	*Urticaceæ.*	*Lemnaceæ.*
Rutaceæ.	Ericaceæ.	*Cannabineæ.*	Liliaceæ.
Ilicineæ.	Pyrolaceæ.	*Ulmaceæ.*	Melanthaceæ.
Celastrineæ.	*Monotropeæ.*	Betulaceæ.	Smilaceæ.
Rhamneæ.	Plumbagineæ.	Salicineæ.	*Asparageæ.*
Sapindaceæ (Acer).	Primulaceæ.	Euphorbiaceæ.	Junceæ.
Anacardiaceæ.	*Oleaceæ.*	*Buxineæ.*	Cyperaceæ.
Leguminosæ.	*Asclepiadeæ.*	Empetreæ.	Gramineæ.

* "The six families which take their names from the rose, the ranunculus, the saxifrage, the primrose, the campanula, and the gentian" (*l. c.* p. 565).

The following show the number of genera, species, and subspecies belonging to each of the chief natural orders in the general flora of the Alps, and in that of the higher zone above the level of deciduous trees:

For the Alpine Flora in General.

Natural Order.	No. of Genera.	Species.	Sub-species.
Compositæ	62	250	60
Leguminosæ	20	134	24
Gramineæ	48	134	13
Cruciferæ	26	115	18
Cyperaceæ	9	108	5
Caryophylleæ	17	101	18
Umbelliferæ	37	94	14
Scrophularineæ	16	83	10
Rosaceæ	16	82	18
Ranunculaceæ	15	71	22
Labiatæ	26	67	7
Liliaceæ	13	43	6
Saxifrageæ	4	42	9
Campanulaceæ	6	42	4
Orchideæ	22	40	6
Primulaceæ	8	36	8
Boragineæ	15	31	4
Rubiaceæ	3	30	9
Salicineæ	2	29	3
Junceæ	2	27	4
Gentianeæ	6	26	6
Geraniaceæ	4	24	0
Polygonaceæ	3	24	2
Crassulaceæ	3	22	10
Euphorbiaceæ	2	20	2
	Genera.	Species.	Sub-species.
25 orders include	385	1675	282
71 remaining orders include	138	335	53

In the Higher Zone of the Alps.

Natural Order.	No. of Genera.	Species.	Sub-species.
Compositæ	38	145	30
Cruciferæ	17	74	11
Leguminosæ	15	72	6
Caryophylleæ	10	71	10
Gramineæ	16	66	6
Cyperaceæ	5	63	4
Scrophularineæ	16	53	8
Rosaceæ	11	49	5
Umbelliferæ	18	45	7
Ranunculaceæ	9	41	7
Labiatæ	16	39	4
Saxifrageæ	4	37	6
Campanulaceæ	2	30	4
Primulaceæ	6	29	6
Gentianeæ	3	23	1
Orchideæ	11	19	2
Junceæ	2	18	2
Liliaceæ	8	17	0
Crassulaceæ	2	16	5
Rubiaceæ	2	16	3
Salicineæ	1	16	0
Violarieæ	1	12	3
Polygonaceæ	3	11	0
Onagrarieæ	2	10	3
Valerianeæ	2	10	0
	Genera.	Species.	Sub-species.
25 orders include	220	982	133
35 remaining orders include	59	135	17

(Proc. R. Geogr. Soc. 1879, p. 568.)

Mr. Ball has, however, not confined the Table to the local problem. He has traced out the distribution of each species of the Alpine flora in the other mountain-ranges of Europe. The usefulness of this feature of his work to those who study geographical botany must at once be obvious. The result was to confirm him in his belief that the Alpine flora owed comparatively little to a migration from the Arctic flora. In this respect he seemed somewhat alarmed at appearing to come into conflict with the views of Mr. Darwin and of Sir Joseph Hooker in the well-known classical paper by the latter published in the Transactions of this Society. But, as Sir Joseph Hooker very properly pointed out, "neither Mr. Darwin nor Professor A. Gray nor himself had ever dealt with

the problem of the birthplace of the species composing the Arctic or Alpine floras. They had been content to follow the comparatively tame process of taking the plants under the conditions in which they were now placed, and following them in their later migrations to the positions they now occupy." (Proc. R. Geogr. Soc. 1879, p. 589.)

For convenience of reference I will quote the position at which Mr. Ball finally arrived:—

"Of the species included in the Alpine flora, 17 per cent. are common to the Arctic flora, and 25 per cent. are common to the Altai range, while the Arctic flora has 40 per cent. common to the Alps and 50 per cent. common to the Altai, using this as a collective name for the ranges of Northern Asia.

"Now if, in deference to the great authorities I have named, I were to admit that every one of the Arctic species common to the Alps had originally reached the mountains of Central Europe by migration from the north, I ask how far that would avail towards an explanation of the origin of the Alpine flora? If we had accounted for 17 per cent. of the species, what should we have to say of the remaining 83 per cent., including at least four generic types peculiar to the Alps, and a very large number not found in the Arctic regions—of the genera present in the higher zone of the Alps only one-half being Arctic? Is it credible that, in the short interval since the close of the glacial period, hundreds of very distinct species and several genera have been developed in the Alps, and—what is no less hard to conceive—that several of these non-Arctic species and genera should still more recently have been distributed at wide intervals throughout a discontinuous mountain-chain some 1500 miles in length, from the Pyrenees to the Eastern Carpathians? Nor would the difficulties cease there. You would have left unexplained the fact that many of these non-Arctic types which are present in the Alps are represented in the mountains of distant regions, not by the same, but by allied species, which must have descended from a common ancestor: that one species of *Wulfenia*, for example, inhabits one small corner of the Alps, that another is found in Northern Syria, while a third allied species has its home in the Himalaya" (*L. c.* p. 576.)

The subject is an undoubtedly complex one. But, for my own part, I am not so much impressed with the difficulties as Mr. Ball. The Alpine flora is certainly very ancient, but it is scarcely possible to doubt that it is a survivor, and, as M. Alphonse de Candolle points out, probably a decaying survivor, of one of which the extension was at some former time far more considerable. I think that in his conclusions Mr. Ball may have pressed the facts rather too hard, and that he has overlooked the enormous amount of extinction which may have taken place in the Arctic flora as we now know it. A mountain flora appears to me to be essentially a flora of refuge, and an island flora is the fact in geographical distribution with which it best admits of comparison.

It seemed desirable to state in this introductory note the results which, so far as could be ascertained, the author was himself disposed to draw from his labours. But it must be borne in mind that the value of the Table as it is now presented to the Society is wholly independent of any theoretical considerations.

DISTRICTS.

1 Val Tinca and Italian portion of the Var.
2 Col di Tenda from Limone to Sospello.
3 Val Stura—Valdieri and Vinadio.
4 Val Maira and Val Grana.
5 Sources of the Po and Val Vraitta—Monte Viso.
6 Val Chisone—Val Pellice—Fenestrelles.
7 Genèvre—Dora to Exilles.
8 Mont Cenis—Susa—Col de Clairée.
9 Alps of Lanzo and Viu.
10 Val Orca—Val Campea.
11 Cormayeur—Dora Baltea to Villeneuve—Little St. Bernard.
12 Val di Cogne—Mont Emilius—Val Champorcher.
13 Great St. Bernard—Val Pellina and Val St. Bartelemi.
14 Val d'Aosta—Villeneuve to Ivrea.
15 Val Tournanche—Val d'Ayas—Val de Lys.
16 Val Sesia to Varallo—Orta.
17 Val Anzasca—Val Antrona.
18 Valley of the Tosa—Simplon to Domo d'Ossola.
19 Val Intrasca—Val Canobbio.
20 Val Maggia—Val Verzasca—Val Onsernone.
21 Val Levantina.
22 Lugano—Monte Generoso—West side of Lake of Como.
23 Splügen—Val Bregaglia.
24 Morbegno—Poschiavo—Tirano.
25 Stelvio—Val Furva—Val Viola.
26 Lecco—Corno di Canzo—Brianza—Legnone—Grigna.
27 Val Brembana—Val Seriana—Bergamasco.
28 Val Camonica—Lago d'Iseo.
29 Val Trompia—Brescia.
30 Val Sabbia—Lago d'Idro—Val Chiese.
31 Val Vestino—Val di Ledro—West side of Lago di Garda.
32 Val di Sarca to Tione—Molveno.
33 Val Rendena.
34 Monte Baldo—Val Arsa—Roveredo.
35 Trento—Val dell' Adige to Botzen.
36 Val di Non—Val di Sole.
37 Val Venosta—Ultenthal—Stilfserthal.
38 Bolzano—Valley of the Rienz—Schleeren—Brenner.
39 Val di Fiemme—Val di Fassa.
40 Veronese—Val Pantena, &c.
41 Recoaro—Val de' Signori.
42 Val Astico.
43 Val Sugana to Bassano.
44 Feltre—Agordo—Val del Cordevole.
45 Cadore—Sources of the Piave.
46 Conegliano—Val Zelline.

47 Tagliamento and Fella.
48 Cividale—Val Torre—Val Natisone.
49 Isonzo above Tolmino.
50 Gorizia—Idria.

Abbreviations for Distribution on the other Mountains of Europe.

F = French Alps.
A = Swiss Alps.
G = German Alps.
I = Illyrian Alps.
L = Ligurian Apennines.
C = Central Apennines.
N = Neapolitan Apennines.
P = Pyrenees.
S = Scandinavia.
K = Carpathians.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Atragene alpina, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 . 4 . 6 7 8 .	. . . . 4 5 6 7 8 9
Clematis Vitalba, *Linn.*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Viticella, *Linn.*	. . . .	. . . .	. . . .
—— recta, *Linn.*	. . . . 8 9	. . . . . . 6 . . 9	0 . 2 3 4 5 6 7 8 9
Thalictrum flavum, *Linn.*	. . . . . . 7 8 .	. . . .	. . 2 . 4 . 6 . . .
—— angustifolium, *Linn.*	. . . .	. . . . . . ? . . .	. 1 2 . . . . 7 8 .
—— galioides, *Nestl.*	. . . . ?	. . . .	. . . .
—— exaltatum, *Gaud.*	. . . .	. . . .	. . 2 . 4 . . . . .
—— minus, *Linn.*	1 2 3 4 . . 7 8 9	. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— elatum, *Jacq.*	. . . .	. . . . 4	. . 2 . . . 6 7 . .
—— fœtidum, *Linn.*	1 . . 4 . 6 . 8 .	0 1 2 . 4 5 6 7 8 .	0 1 ? . 4 5 . 7 8 .
—— alpinum, *Linn.*	1 . 3	. . . .	. . . . . 5 . . . .
—— aquilegifolium, *Linn.*	1 2 3 4 . . 7 8 9	0 . 2 . . 5 6 7 8 .	0 1 2 . 4 5 6 7 8 9
Anemone vernalis, *Linn.*	. . . . . 6 . 8 .	. 1 2 . 4 5 6 . 8 .	0 . 2 . 4 5 6 . 8 .
—— Halleri, *All.*	. . . . . 6 . 8 .	. 1 2 . 4 . ? . . .	. . . . 4 . . . . .
—— Pulsatilla, *Linn.*	. . . 4 . . . 8 .	. . 2 . 4	. . . . . . 6 . 8 .
—— montana, *Hoppe*	. . . .	 9	. . . . ? . . 7 . .
—— coronaria, *Linn.*	. . . .	. . . .	. . . .
—— narcissiflora, *Linn.*	1 2 . 4 5 . . 8 9	. . . . 7 8 .	. . 2 . 4 . . 7 8 9
—— alpina, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (A. sulphurea, *Linn.*)	1 . 3 . . . . 8 .	. . 2 3 . . 6 . 8 .	0 1 2 . 4 5 6 7 8 9
—— ——, var. (A. millefoliata, *Bert.*)	. . . .	. . . . . 5	0 1 9
—— baldensis, *Linn.*	1 2 . 4 5 6 . 8 .	. 1 2 3 . 5 6 . 8 .	 9
—— nemorosa, *Linn.*	1 2 . 4 . . . 8 9	. . . . . . 6 7 . 9	0 1 2 . 4 5 6 7 8 .
—— ranunculoides, *Linn.*	. 2 . . . . . 8 .	. . . . . . 6 . . 9	. . 2 . . . 6 7 8 .
—— trifolia, *Linn.*	. . . .	. . . .	. . . .
—— hepatica, *Linn.*	1 2 3 4 5 . 7 8 9	0 . 2 . 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
Adonis æstivalis, *Linn.*	. . . 4 . . . 8 .	. . . . . . ? . . .	. . . . . 5 . . 8 .
Ranunculus aquatilis, *Linn.*	1 2 . . . . . 8 9	. . 2 . 4 5 6 . 8 9	. 1 2 . 4 5 6 7 8 .
—— ——, var. (R. ololeucos, *Lloyd*)	. . . .	. . 2	. . . .
—— fluitans, *Linn.*	. . . . 8 .	. . . . . . 6 . 8 9	. . . . . 5 . . . .
—— divaricatus, *Schrank*	. . . .	. . . .	. . . . 7 . .
—— rutæfolius, *Linn.*	. 2 . . 5 6 . 8 .	. . 2 . . . 6 . 8 .	 9
—— ——, var. (R. anemonoides, *Zahlb.*)	. . . .	. . . .	. . . .
—— glacialis, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 .
—— Seguieri, *Vill.*	1 2	. . . .	. . . . 8 9
—— alpestris, *Linn.*	1 2 . . . . 7 8 9	. 1 . . . . 6 . 8 .	0 . . . 4 5 6 7 8 .
—— Traunfellneri, *Hoppe*	. . . . ?	. . . .	. . . .
—— Bertolonii, *Hausm.*	. . . .	. . . .	 9
—— aconitifolius, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— lacerus, *Bell.*	. 2	. . . .	. . . .
—— parnassifolius, *Linn.*	. . . .	. 1	. . . . . 5 . . . .
—— pyrenæus, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	. 1 . . 4 5 . 7 8 .
—— gramineus, *Linn.*	1 . . . . . . 8 .	. . . . . . ? . . .	. . . .
—— Flammula, *Linn*	. . . . . . 7 8 9	. . . . 4 . ? . . 9	. 1 2 3 . . 6 7 . .
—— reptans, *Linn.*	. . . .	. . . . 4 . 6 . 8 .	. . 2 . 4 . 6 7 8 .
—— Lingua, *Linn.*	. . . . 8 .	. . . . . . ? . . 9	. . 2 . . . . 7 . .
—— Ficaria, *Linn.*	1 2 . 4 . . . 8 .	. . . . 4 . 6 . 8 9	. . 2 . 4 . 6 7 8 .
—— Thora, *Linn.*	. 2 3	. . 2 . . 5 6 7 . .	. . 2 . 4 . 6 7 8 9
—— hybridus, *Biria*	. . . .	. . . .	. . ? . 4 5 . . 8 .
—— pygmæus, *Wahlenb.*	. . . .	. . . .	. . . .
—— auricomus, *Linn.*	. . . . 5 . 7 . .	. . . .	. . . . . 5 . . 8 .
—— cassubicus, *Linn.*	. . . .	. . . .	. . . .
—— montanus, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Gouani, *Willd.* (? Auct. Gall.)	. . ?	. . . .	. . . . ? ? .
—— aduncus, *Gren. et Godr.* (?)	1 2 3 4 5	. . . . . . ? . . .	. . . .
—— Villarsii, *DC.*	1 2 . . . 6 . 8 .	. . . .	. . . . . 5 . 7 . .
—— polyanthemos, *Linn.*	. . . .	. ? . . . ?	. . . .

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L . . P . K	Atragene alpina.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	Clematis Vitalba.
. . . . 4	. . . .	.	. . . I . C	—— Viticella.
0 1 2 3 4 5 6 . . .	0 1 2 3 4 . 6 7 8 9	50	F ? . I L C N P . K	—— recta.
. . . . 4 5 . 7 . 9	0 1 2 3 . 5 . . 8 9	50	F A G I L C N P S K	Thalictrum flavum.
. . . . 4 5 6 7 8 9	0 . 2 3 4 5 . 7 8 .	50	F . G I L C N . S K	—— angustifolium.
. . . . 4 5 . . 8 9	. . . . 4 5 6 . . 9	.	F A G ? . . . ? S ?	—— galioides.
. . . .	. . . .	.	F	—— exaltatum.
0 1 2 . 4 5 6 . . 9	0 1 2 3 4 5 6 7 . .	50	F A G I L C N P S K	—— minus.
. . 2 . . 5 . 7 8 9	0 1 2 3 4 5	.	. . . I . . . . . K	—— elatum.
. . . . . 5 6 7 8 9	. . . . 4 . . 7 . .	.	F A G I L . N . . K	—— fœtidum.
. . . . 7 8 9	. . . . . 5 . 7 . .	.	F A G I . . . P S K	—— alpinum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . . 7 8 9	50	F A G I L C N P S K	—— aquilegifolium.
. . 2 3 . 5 6 7 8 9	. . . 3 4	.	F A G . . . . P S K	Anemone vernalis.
. . . ?	. . . .	.	F A G . . . . . . K	—— Halleri.
. 1 . . 4 . . 7 8 .	0 1 . 3 . . 6 7 8 .	50	F A G I L C . P S K	—— Pulsatilla.
. 1 . . . 5 . 7 8 .	. . . .	.	F A G I . . . . . K	—— montana.
. . . . 4	. . . .	.	F . . I L C N . . .	—— coronaria.
0 . 2 . . . . . 8 .	. . . 3 4 . . . 8 .	.	F A G I L C N P S K	—— narcissiflora.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . .	.	F A G I L . N P S K	—— alpina.
. . . 3 4 . 6 7 8 9	. . . 3 4 . . 7 . .	.	F A G	—— ——, var. (A. sulphurea).
. . . . 4	. . . 3 4	.	. . . . L C N . . .	—— ——, var. (A. millefoliata).
0 . . 3 4 5 6 7 8 9	. 1 2 3 4 5 . . . 9	.	F A G I . . . P . K	—— baldensis.
. . . 3 4 . 6 7 8 .	. . . 3 . . . 7 8 .	50	F A G I L C N P S K	—— nemorosa.
. . . . 4 5	0 . 2 3 . . . 7 . .	50	F A G I L C N P S K	—— ranunculoides.
. . . . 4 5 . . 8 9	0 1 2 3 4 5 . 7 8 9	50	. . G I L C	—— trifolia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— hepatica.
. . . . 4 5 . . 8 9	0 1 . 3	.	F A ? I L C N P . K	Adonis æstivalis.
. . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . .	.	F A G I L C N P S K	Ranunculus aquatilis.
. . . .	. . . .	.	. . . .	—— ——, var. (R. ololeucos).
. . . . 4 5 . . 8 .	0 1	.	? A G . . . . ? . K	—— fluitans.
. . 2 . . 5	. . . 3	.	F A G I . . . P S K	—— divaricatus.
. . . 3 4 5 . 7 8 9	. . . 3 . . 6 . . .	.	F A G I . . . P . K	—— rutæfolius.
. . . . 4	. . . .	.	. . G . . . . . . K	—— ——, var. (R. anemonoides).
0 . 2 3 . . 6 7 8 9	. . 2 3 4 . . 7 . .	.	F A G I L . . P S K	—— glacialis.
. . . 3 4 5 . . 8 9	. . . 3 4 5	.	F . G I L . N . . .	—— Seguieri.
. . 2 3 4 5 . 7 . 9	. . . . 4 5 . 7 8 9	.	F A G . . . N P . K	—— alpestris.
. . . . ? . .	. . . . 7 . .	.	. A G I . . . . . K	—— Traunfellneri.
. 1	. . . .	.	. . G . . . N . . K	—— Bertolonii.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P S K	—— aconitifolius.
. . . .	. . . .	.	F A	—— lacerus.
. . . . 7 8 9	. . . .	.	F A G . . . . P . .	—— parnassifolius.
. . . . . . 6 7 8 9	0 . . 3	.	F A G . L . . P . .	—— pyrenæus.
. . . .	. . . .	.	F A . . L C N P . .	—— gramineus.
. . . 3 . 5 . 7 8 9	. . . 3 4 . . 7 8 .	.	F A G I L C N P S K	—— Flammula.
. . . . . 5 . 7 8 9	. . . .	.	. A G . . . . . S K	—— reptans.
. . . . . 5 . 7 . .	. . . 3 . . . 7 . .	.	. . G I . C . . S K	—— Lingua.
. . . 3 4 5 . 7 8 .	0 1 2 3 . . . 7 . .	50	F A G I L C N P S K	—— Ficaria.
. 1 2 3 4 5 . . 8 9	. 1 2 3 4 5 6 7 . 9	.	F A G I . . N P . K	—— Thora.
. . 2 . 4 . . . 8 9	. . . . 4 5 . 7 . 9	.	. . G I . . N . . K	—— hybridus.
. . . . 7 8 .	. . . .	.	. . G . . . . . S .	—— pygmæus.
. . . . 4 . . . 8 9	0 . . 3 . . . 7 . .	.	F A G I L C ? P S K	—— auricomus.
. . . .	. . . . 7 . ?	50	. . . ? . . . . S K	—— cassubicus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— montanus.
. . . . 9	. . . 3	.	? . . . . . N P . ?	—— Gouani.
. . . .	. . . . . ?	.	F . . . . ?	—— aduncus.
. . 2 3 4 5 . 7 . 9	. . 2 3 4 5	.	F A G I L . . P . K	—— Villarsii.
. . . . 7 . .	. . . . ? . .	.	. . G . . . . . S K	—— polyanthemos.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Ranunculus polyanthemos, var. (R. nemorosus, *DC.*)	. . 3 . . . 7 8 .	. 1 . . 4 5	. . . . ? . . 7 8 9
—— acris, *Linn.*	1 2 3 4 . . . 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— lanuginosus, *Linn.*	. 2 3 4 . . . 8 9	. . . . . . 6 . . .	. . 2 . 4 . 6 7 8 9
—— repens, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— bulbosus, *Linn.*	1 2 3 4 . . 7 8 9	. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— illyricus, *Linn.*	. . . .	. . . .	. . . .
—— ——, var.? (R. saxatilis, *Balb.*)	1	. . . . 4	. . . .
—— philonotis, *Ehrh.*	. . . 4 . . . 8 .	. . . . . . ? . . .	. . . . 7 8 .
—— sceleratus, *Linn.*	. . . .	. . . . . . 6 . . 9	. . 2 . 4 . 6 . 8 .
—— arvensis, *Linn.*	1 2 . 4 . . 7 8 .	. . . . . . 6 . . 9	. . 2 . 4 5 6 7 8 9
—— parviflorus, *Linn.*	1 . . . . 6 . . .	. . . .	. . . . . . 6 . 8 .
—— falcatus, *Linn.*	1	. . . .	. . . .
Caltha palustris, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9
Trollius europæus, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
Eranthis hyemalis, *Salisb.*	?	 9	. . . .
Helleborus niger, *Linn.*	. ?	. . . ? ? . ? . 8 .	. . 2 . . . 6 7 8 9
—— viridis, *Linn.*	. 2 3 . . . 7 . .	. . . . . . 6 . . 9	. . 2 . . . 6 7 8 9
—— fœtidus, *Linn.*	1 2 3 . . . 7 . .	. 1 . . 4 . 6 . 8 9	. . 2 . . 5 6 7 8 9
Isopyrum thalictroides, *Linn.*	. . . . ? .	. . . . . . 6 . . .	. . . . 4 . . . . .
Nigella arvensis, *Linn.*	. . . .	. . . .	. . . . 4 . . . . .
—— damascena, *Linn.*	1	. . . .	. . . . 8 .
Aquilegia vulgaris, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 . . 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9
—— atrata, *Koch*	. . ? ? . 6 ? . .	. . . .	. . . . . ? ? 7 8 .
—— Hænkeana, *Koch* ?	. . . .	. . . .	. . . .
—— Reuteri, *Boiss.*	1 2 3 4 5	. . . ?	. . . .
—— alpina, *Linn.*	1 2 3 . 5 6 . 8 9	. 1 2 . 4 5 6 . . .	. 1 . . . . 6 7 8 9
—— pyrenaica, *Bert.* (an *DC.*?)	. . . .	. . . .	. . 2 . . . 6 7 8 9
Delphinium Consolida, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 . . .	0 . 2 . 4 5 6 . . 9
—— ——, var. divaricatum	. . . .	. . . .	. . . .
—— elatum, *Linn.*	1 2 9	. . . . ? . . ? . .	. . . .
—— ——, var. montanum, *DC.*	. . 3 ? 5 6 . . .	. . . . 4 . ? . . .	. . . .
Aconitum Anthora, *Linn.*	1 . 3 . . 6 . 8 .	. . . . . . 6 . 8 .	. . 2 . 4 . 6 7 . .
—— Napellus, *Linn.*	1 2 3 4 5 6 7 8 9	0 . 2 . . . . 7 8 9	0 1 2 3 4 5 6 7 8 9
—— variegatum, *Linn.*	. . . .	. . . .	. 1 . . . .
—— paniculatum, *Lam.*	1 . 3 . . . . 8 .	. . 2 3 4 5 6 7 8 .	. . . . 4 5 6 7 8 9
—— Lycoctonum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	. 1 2 3 4 5 6 7 8 9
Pæonia corallina, *Retz.*	. . . .	. . . .	. . . . 8 .
—— officinalis, *Retz.*	. 2 . 4 . . . 8 .	. . . .	. . 2 . . . 6 7 . 9
—— ——, var. (P. peregrina, *Mill.*)	. ? . . . . . 8 .	. . . .	. . 2 . . . .
Actæa spicata, *Linn.*	1 2 3 4 . . . 8 9	. . 2 . 4 5 6 7 8 9	. . 2 . 4 5 6 7 8 9
Berberis vulgaris, *Linn.*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Epimedium alpinum, *Linn.*	. . . .	. . . . ? . ? . . .	. . 2 . . . 6 . . .
Nymphæa alba, *Linn.*	. . . . 8 .	. . . .	. . 2 . 4 . . . 8 .
Nuphar luteum, *Sm.*	. . . .	. . . .	. . 2 . 4 . . . 8 .
Chelidonium majus, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Papaver alpinum, *Crantz*	. . . .	. . . .	. . . . . 5 6 . 8 .
—— ——, var. (P. pyrenaicum, *W.*)	. 2	. . . . . . ? ? . .	. . . . 4 5 . . . .
—— Argemone, *Linn.*	. 2 3 4 . . 7 8 9	0	. . 2 . 4 . 6 . . .
—— hybridum, *Linn.*	. . . . . 6 . 8 .	 9	. . . .
—— Rhœas, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 . 2 . 4 5 6 7 8 9
—— dubium, *Linn.*	1 2 3 4 5 6 7 8 .	. . . . 7 8 .	. . . . . 5 . . 8 .
Corydalis cava, *Fl. Erl.*	. . . 4 . . . 8 .	. . . . . . 6 . 8 9	. . . . 4 . 6 . . .
—— solida, *Sm.*	1 2 3 . . 6 . 8 .	. . 2 . 4 9	. . 2 . 4 . . 7 . .
—— fabacea, *Pers.*	. 2 . . . 6 . . .	. . . . . . 6 . . .	. . . .
—— lutea, *DC.*	. . . .	. . . .	. . 2 . . 5 6 7 8 9
—— ochroleuca, *Koch* ?	1 2	. . . .	. . . . . . 6 7 . .
—— Gebleri, *Ledeb.*	. . . .	. . . .	. . . .
Matthiola varia, *DC.*	. . . .	. . 2 . . . . . 8 .	. . . .
Nasturtium officinale, *R. Br.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . 2 . 4 . 6 7 8 9	0 . . 3 4	.	F A G I L C N P S K	Ranunculus polyanthemos, var. (R. nemorosus).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— acris.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— lanuginosus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— repens.
0 1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— bulbosus.
. . . .	. . . .	.	. . . I . . N . S .	—— illyricus.
. . . .	. . . .	.	. . . . L	—— ——, var. ?
. . . . 4 5 . 7 8 .	. . . 3 4 . . 7 . .	.	F A G I L C N P S K	—— philonotis.
. . 2 . 4 5 . 7 8 9	0 1 . 3 . . . 7 . .	.	. A ? I . C N P S K	—— sceleratus.
0 1 2 . 4 5 6 . 8 9	0 1 2 3 . . 6 7 8 .	50	F A G I L C ? P S K	—— arvensis.
. 1 . . 4 9	0 . . 3	.	. . . I L C ? . . .	—— parviflorus.
. . . . ? . .	. . . .	.	F . . I . C N ? . K	—— falcatus.
0 . 2 . 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	.	F A G I L C N P S K	Caltha palustris.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P S K	Trollius europæus.
. . . .	0 1 2 3	.	F A . I L C N . . .	Eranthis hyemalis.
0 1 2 3 4 5	0 1 2 3 4 5 6 7 . 9	50	F A G I L C . . . K	Helleborus niger.
0 1 2 3 4	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— viridis.
0 1 2 3 4	0 1	.	F A G . L C N P . .	—— fœtidus.
. . . . 4	. . 2 3 . . . 7 8 .	.	F A . I . C . P . K	Isopyrum thalictroides.
. . . .	. . . .	50	. . . I L C N P . K	Nigella arvensis.
. . . .	?	.	. . . I L C N P . ?	—— damascena.
0 . 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 . 9	.	F A G I L C N P S K	Aquilegia vulgaris.
? ? . 3 . 5 . . 8 9	. 1 . 3 4 . . 7 . .	.	. A G I L ?	—— atrata.
. . . .	. . . . 7 8 9	50	. . G I	—— Hænkeana.
. . . .	. . . .	.	F . . . . ?	—— Reuteri.
0	. . ?	.	F A . . . C	—— alpina.
0 1 . 3 4 . . . 8 9	. . 2 3 4 5 6 7 . 9	50	. . G I L C N . . .	—— pyrenaica.
0 1 2 . 4 5 . 7 8 .	0 1 2 3 4 5 . . 8 .	50	F A G I L C N P S K	Delphinium Consolida.
. . 2 . . 5	. . . 3	.	. . . I . C N . . .	—— ——, var. divaricatum.
. . . .	. . . .	.	F A G ? . . . P S K	—— elatum.
. . . . ?	. . . 3 4	.	F ? . . . . . P . K	—— ——, var. montanum.
. . . . 4	0 . . 3 4 5	50	F A G I . . . P . K	Aconitum Anthora.
0 . 2 . 4 5 6 7 8 9	0 . 2 3 4 5 6 7 8 9	.	F A G I ? . . P S K	—— Napellus.
. . . . 4 . . 7 8 .	. 1 . 3 . . . 7 . .	50	. ? G I . ? . . . K	—— variegatum.
. 1 2 3 4 5 6 7 8 9	0 . . . 4 5 . 7 . .	.	F A G I . C . . . K	—— paniculatum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P S K	—— Lycoctonum.
. . . .	. . . 3 . . 6 7 . .	.	. . G I . C . . . K	Pæonia corallina.
0 1 2 3 4 5 6 . 8 .	0 1 . 3 4 . 6 7 . .	50	? . . I ? C N . . .	—— officinalis.
. . . .	. . . .	.	. A ? . I . C . . . K	—— ——, var. (P. peregrina).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Actæa spicata.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Berberis vulgaris.
0 1 2 . 4 5	0 1 2 3 . 5 6 7 . .	50	. . G I	Epimedium alpinum.
. . . . 4 5 . 7 8 .	?	.	F A G I ? C N P S K	Nymphæa alba.
. . 2 . . 5 . . 8 9	0	.	F A G I L C N P S K	Nuphar luteum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9	50	F A G I L C N P S K	Chelidonium majus.
. . 2 3 4 . . 7 8 9	. . 2 3 4 5 6 7 . 9	.	F A G I . . N . S K	Papaver alpinum.
. . . . 4 9	. . . . 4	.	F A G . . . N P . .	—— ——, var.
0 1 2 3 4 . . . 8 .	0 1 . 3 . . . 7 8 9	50	F A G I L C N P S K	—— Argemone.
. . . .	. . . .	.	? . . I L C N P . K	—— hybridum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— Rhœas.
0 . . . . 5 . 7 8 9	. 1 . 3	.	F ? ? I L C N P S K	—— dubium.
. . . . 4 5	0 . . 3 . . . 7 . .	50	F A G I L C N P S K	Corydalis cava.
. . . 3 . 5 . 7 8 9	0 1 . 3 4 . . 7 . 9	.	F A G I ? ? ? P S K	—— solida.
. . . . . 5 . 7 8 .	. . . 3	.	F A G . . C N . S .	—— fabacea.
0 1 2 3 4 5 6 . 8 9	. 1 . . 4	.	. . . I . . . ? . .	—— lutea.
. 1 2 . ? ?	0	50	. . . I . C N . . K	—— ochroleuca.
. . . . 8 .	. . . . 4	.	. . . . K	—— Gebleri.
. 1 . . 4	. . . . 7 . .	.	. A	Matthiola varia.
0 1 2 3 4 5 . 7 8 9	0 1 . 3 4 5 . 7 8 9	50	F A G I L C N P S K	Nasturtium officinale.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Nasturtium amphibium, *R. Br.*	1	. . . .	. . 2 . . . 6 7 8 .
—— sylvestre, *R. Br.*	1 2 . . . . . 8 .	. . . . . . 6 . 8 9	0 . 2 . . . 6 7 8 9
—— palustre, *DC.*	. . . ? . . . 8 .	. . . . 4 . 6 7 8 9	. . . 3 4 . 6 . 8 .
—— lippizense, *DC.*	. . . .	. . . .	. . . .
—— pyrenaicum, *R. B.*	. 2 3 . . . . 8 9	. . . . 4 5 6 7 . 9	. . . 3 4 5 . . 8 .
Barbarea vulgaris, *R. Br.*	1 2 3 4 . . 7 8 9	. . . . . . 6 . . 9	. . 2 . 4 5 6 7 8 .
—— ——, var. (B. arcuata, *Reichb.*)	. . . ?	. . . .	. . . . 7 . .
—— ——, var. (B. stricta, *Andrz.*)	. . . .	. . . .	. . . .
—— intermedia, *Bor.*	. . . . . 6 . . .	. . . . 4	. . . .
—— bracteosa, *Guss.*	. . . .	. . . .	. . . . . . 6 7 . .
Turritis glabra, *Linn.*	1 2 3 4 . . . 8 9	. . . . . . 6 . . 9	0 . 2 . 4 5 6 7 8 .
Arabis brassicæformis, *Wallr.*	1 2 3 . . 6 7 8 .	. . . . . 5 6 . . .	. . . . . . 6 7 8 .
—— pedemontana, *Boiss.*	. . . . 5 6 . . .	. . . .	. . . .
—— alpina, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— auriculata, *Spreng.*	1 2 . 4 . 6 . 8 .	. . . . 4 . . . . ?	. . . . . ? . . . .
—— saxatilis, *All.*	. . . 4 . . 7 8 .	. . . .	. . . .
—— Gerardi, *Bess.*	1	. . . .	. . . .
—— hirsuta, *Scop.*	1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 8 9	0 . 2 . 4 5 6 7 8 9
—— ——, var. (A. sagittata, *DC.*)	. . . .	. . . .	. . . .
—— ciliata, *R. Br.*	. 2 3 . . . 7 8 9	. . . . . 5 6 . 8 .	0 . 2 . . 5 . 7 . 9
—— ——, var. hirsuta, *Koch*	. . . 4 5 . 7 8 9	0 1 2 3 4 . 6 7 8 9	0 1 . 3 4 5 6 . 8 .
—— cenisea, *Reut.*	. . . . 8 .	. . . .	. . . .
—— serpyllifolia, *Vill.*	1	. . . .	. . . . 7 . ?
—— muralis, *Bert.*	1 2 . 4 . . . 8 .	. . . .	. . 2 . . . 6 . . .
—— stricta, *Huds.*	. . . . ? . 7 8 .	. . . .	. . . .
—— Scopoliana, *Boiss.*	. . . .	. . . .	. . . .
—— vochinensis, *Spreng.*	. . . .	. . . .	. . . .
—— arenosa, *Scop.*	. . . .	. . . .	. . . .
—— Halleri, *Linn.*	. . . .	. . . . . 5 6 7 8 9	. . . . 4 . 6 7 8 9
—— turrita, *Linn.*	1 2 3 4 . 6 7 8 9	. . . . . . 6 . . 9	. . 2 . 4 5 6 7 8 .
—— pumila, *Jacq.*	. . . . 8 .	. . . . 8 .	. . . 3 4 5 6 7 8 9
—— Allionii, *DC.*	. 2 3 . . . . 8 .	. . . .	. . . .
—— bellidifolia, *Jacq.*	1 2 3 4 . . 7 8 .	. . . . . 5 . 7 8 .	. 1 . . 4 5 . 7 . 9
—— cœrulea, *Hænke*	. . . . . 6 7 8 .	0 1 2 3 . 5 6 7 . .	0 . . 3 . 5 . 7 8 .
Cardamine asarifolia, *Linn.*	1 2 3 . 5 6 . 8 9	. . . .	. . 2 . 4 . 6 7 8 9
—— alpina, *Willd.*	1 2 . . . . 7 8 9	0 1 2 3 . 5 6 7 8 .	0 1 . 3 4 5 . . 8 .
—— ——, var. subtriloba, *Koch*	. . . .	. . . . . . 6 . . .	. . . 3 . 5 . . . .
—— resedifolia, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Plumieri, *Vill.*	. 2 . . 5 6 . 8 9	0 . . . . 5 6 . . .	. . . .
—— impatiens, *Linn.*	1 2 3 4 . 6 7 8 9	0 . . . 4 5 6 7 8 9	0 . 2 . 4 5 6 7 8 .
—— hirsuta, *Linn.*	1 2 . 4 . 6 . 8 9	. . . . . . 6 7 . .	. 1 2 . 4 5 6 7 8 9
—— ——, var. (C. sylvatica, *Link*)	. . . .	. . . .	. . 2 . 4 . . . . .
—— pratensis, *Linn.*	 9	. . . . . . 6 . . 9	. . 2 . 4 . . . . .
—— ——, var. (C. Matthioli, *Moret.*)	. . . . . 6 . . .	. . . .	. . . .
—— amara, *Linn.*	1 2 3 4 . . . 8 9	0 1 . 3 . . 6 7 8 9	. 1 . 3 4 5 6 7 8 .
—— trifolia, *Linn.*	. . . .	. . . .	. . . .
Dentaria enneaphylla, *Linn.*	. . . .	. . . . . . 6 . . .	. . . . 8 9
—— trifolia, *Waldst. & Kit.*?	. . . .	. . . .	. . . .
—— digitata, *Lam.*	1 2 3 4 . . . 8 .	. . . . 4 5 6 . . .	. . 2 . . 5 . 7 8 9
—— polyphylla, *Waldst. & Kit.*?	. . . .	. . . .	. . . . . 5 6 7 . .
—— pinnata, *Lam.*	1 2 3 4	. . . . 4 . 6 7 8 9	. . 2 . 4 . 6 7 8 .
—— bulbifera, *Linn.*	. 2	. . . . . . 6 . . .	. . 2 . . . 6 7 8 .
Hesperis matronalis, *Linn.*	. 2 . . . . . 8 .	. . . .	. . 2 . . . . . 8 .
—— laciniata, *All.*	1 2	. . . .	. . . .
Sisymbrium officinale, *Scop.*	1 2 3 4 5 . . 8 9	. . . 3 4 . 6 7 8 9	. 1 2 . 4 5 6 7 8 9
—— austriacum, *Jacq.*	1 2 3 . . . . 8 9	. . . . 4 5	. . . .
—— ——, var. (S. acutangulum, *DC.*)	1 2 . . 5 6 7 .	. . 2 3 4	. . . .
—— Irio, *Linn.*	. . . . . . 7 8 .	. . . .	. . . .
—— Columnæ, *Jacq.*	. . . .	. . . . ?	. . . . . ? . . . .
—— pannonicum, *Jacq.*	. . . .	. . . .	. . . .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
0 . 2 . 4	0 . . . . . . 7 . .	.	F A ? I L C N ? S K	Nasturtium amphibium.
. 1 . . 4 5	0 1 . 3 4 5 . 7 8 9	50	F A G I L ? N P S K	—— sylvestre.
. . 2 . 4 . 6 7 8 9	. . . 3 4	.	F A G I ? C N P S K	—— palustre.
. . . .	. . . .	50	. . . I	—— lippizense.
. . . .	. . . .	.	. A . I L C . P . K	—— pyrenaicum.
0 1 2 . 4 5 . 7 8 .	0 1 2 . 4 5 . 7 . .	50	F A G I L C N P S K	Barbarea vulgaris.
. . . .	. . . 3	.	? A G I L . N ? S K	—— ——, var. (B. arcuata).
. 1 . . . 5	. . 2 3 4	.	. . . I L ? . P S K	—— ——, var. (B. stricta).
. . . .	. . . .	.	. . . . P . .	—— intermedia.
. . . .	. . . .	.	. . . . . C N . . .	—— bracteosa.
0 1 2 3 4 5 6 . 8 9	0 . . 3 4 . . 7 . .	.	F A G I L C ? P S K	Turritis glabra.
0 1 2 . 4 5 . 7 . .	. . . .	.	F A G . L . N P . K	Arabis brassicæformis.
. . . .	. . . .	.	. . . .	—— pedemontana.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— alpina.
. . . . . 5 . 7 . .	. . . .	.	F A . I . C N P . K	—— auriculata.
. . 2 . 4 . . 7 . 9	. . . .	.	F A . . . . . P . .	—— saxatilis.
. . . .	. . . .	.	. . . . . C . ? . K	—— Gerardi.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— hirsuta.
. . . . 4 5	. . . .	.	F ? . I L C N P S K	—— ——, var. (A. sagittata).
. . . 3 4 . . 7 . 9	. 1	.	F A G . . . . P . K	—— ciliata.
0 . 2 3 4 . 6 7 8 9	. 1 2 3 4 5 6 7 . 9	.	F A G . . . . P . ?	—— ——, var. hirsuta.
. . . .	. . . .	.	. . . .	—— cenisea.
. . . .	. . . . 7 . .	.	F A . ? . . N P . .	—— serpyllifolia.
. . . . . 5	. . . .	.	F A . I L C N . . .	—— muralis.
. . . .	. . . .	.	F A . . . . . P . ?	—— stricta.
. . . .	. . . .	50	. . . I	—— Scopoliana.
. . . . 4	. . . . 7 . 9	50	. . G I	—— vochinensis.
. . . 3 . 5	. . . .	50	? A G I . . . P S K	—— arenosa.
0 1 2 3 . 5 6 . . .	. 1	.	. . G I . . . . . K	—— Halleri.
0 1 2 . 4 5 6 7 8 .	0 1 2 3 4 . . 7 8 9	50	F A G I L C N P . K	—— turrita.
. 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 . 9	.	F A G I . C N . . K	—— pumila.
. . . .	. . . .	.	F . . . L	—— Allionii.
0 . 2 3 4 5 . 7 8 9	0 . . . 4 5	.	F A G I . . . P . K	—— bellidifolia.
. . 2 3 . . 6 7 8 9	. . . . 4 5 . 7 . 9	.	F A G I . . . . . K	—— cœrulea.
0 . 2 3	. . . .	.	F . . . ? C	Cardamine asarifolia.
. . . 3 4 . 6 7 8 9	. . . 3 4 5	.	F A G I . . . P S K	—— alpina.
. . . . . . 6 . . .	. . . .	.	. . . . P . .	—— ——, var. subtriloba.
0 . 2 3 . 5 6 7 8 9	. . 2 3 4 . . 7 . .	.	F A G I L C . P . K	—— resedifolia.
. . . .	. . . .	.	F . . I L C	—— Plumieri.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— impatiens.
0 1 2 3 4 5 . 7 8 .	0 1 . 3 . . . 7 8 .	50	F A G I L C N P S K	—— hirsuta.
0 . . . 4	. . . .	.	F A G I ? C N P S K	—— ——, var. (C. sylvatica).
0 . . . . . . 7 8 9	0 . . 3 . . . ? . .	.	F A G I L C ? P S K	—— pratensis.
. . . .	?	.	. . . .	—— ——, var. (C. Matthioli).
0 . . 3 . 5 6 7 8 9	. 1 . 3 4 5 . 7 . .	.	F A G I L C N P S K	—— amara.
. . . . 4	. . 2 3 . . 6 7 8 .	50	. . G I L C . . . K	—— trifolia.
0 1 2 3 4 5 . 7 8 9	0 1 . 3 4 . . 7 8 9	50	. . G I . C N . . K	Dentaria enneaphylla.
. . . . . 5 . . 8 9	. . . 3 . . . 7 . .	.	. . G I . . N . . ?	—— trifolia.
0 1 2 3 4 5 . . . 9	. 1 . 3 4 . . 7 8 .	50	F A G I L . . P . .	—— digitata.
. . 2	. . . .	.	. A . I L C N . . .	—— polyphylla.
0 . . 3 4	. . . . 7 . .	.	F A G . L C N P . .	—— pinnata.
0 1 . . 4	0 1 . 3 . . . 7 . .	50	F A G I L C N . S K	—— bulbifera.
. . . .	. . . 3 . . . 7 8 .	.	F A G I ? C N P S K	Hesperis matronalis.
. . . .	. . . .	.	F . . I . C N P . .	—— laciniata.
. 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Sisymbrium officinale.
. . . .	. . . .	.	F A G . . . . P . .	—— austriacum.
. . . .	. . . .	.	F A . . . . . P . .	—— —— var. (S. acutangulum).
. . . .	. . . .	50	. A . I L C N P . ?	—— Irio.
. . . . 8 .	0	.	F . G I L C N . . K	—— Columnæ.
. . . . 7 . .	. . . .	.	. A . I L . . . . K	—— pannonicum.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Sisymbrium Sophia, *Linn.*	. 2 . . . 6 . 8 9	. . 2 3	. . 2 . . 5 6 . 8 .
—— pinnatifidum, *DC.*	. . . . 5 6 . 8 9	0 1 . 3	. . . . . 5 . . . .
—— strictissimum, *Linn.*	. . . .	. 1 2	. . . . 4 5 . . 8 .
—— Alliaria, *Scop.*	1 2 3 4 . . 7 8 9	0 1 . 3 4 5 6 . . 9	0 . 2 3 4 5 6 7 8 9
—— Thalianum, *Gay*	1 2 3 4 5 . . 8 9	. . 2 3 4 . 6 7 8 9	. . 2 . 4 5 6 7 8 9
Hugueninia tanacetifolia, *Reichb.*	1 2 3 4 5 6 7 8 9	. 1 2 3	. . . .
Erysimum cheiranthoides, *Linn.*	. . . .	. . . .	. . . . . . 6 . . .
—— virgatum, *Roth*	. . . . . 6 7 8 .	. . . .	. . . .
—— odoratum, *Ehrh.*	. . ? ?	. . . .	. . . . . . 6 . . .
—— repandum, *Linn.*	. . . . . 6 . . .	. . . .	. . . .
—— canescens, *Roth*	. . . . 8 .	. . . . 4	. . . . 7 . .
—— rhæticum, *DC.*	. . . .	. . . .	. . 2 . 4 . . . . .
—— Cheiranthus, *Pers.*	1 2 . 4 ? . . 8 .	. 1 2 3 4 5 6 7 8 .	0 1 2 3 4 . . 7 8 9
—— ——, var. (E. pumilum, *Gaud.*).	1 2 . . 5 6 7 8 .	. . 2 . . 5 6 7 8 .	. . . .
—— ——, var. (E. helveticum, *Gaud.*)	. . . . ? .	. . 2 . 4 5	. . 2 . 4 . 6 7 . .
—— orientale, *R. Br.*	. . . .	. . . .	. . . .
Brassica Cheiranthus, *Vill.*	1 . 3 4 5 6 7 8 9	. . . . 4 . . . 8 .	0 . . . . . . 7 . .
—— obtusangula, *Bert.*	. . 3 4 . 6 . 8 9	. 1 2 3 4 5 6 . . 9	. . 2 3 . . 6 7 . .
—— repanda, *DC.*	1 . . . . . 7 8 .	. . . .	. . . .
—— Richerii, *Vill.*	1 . . . 5 6 7 8 .	. . . .	. . . .
Sinapis arvensis, *Linn.*	1 2 . 4 5 . . 8 9	0 . 2 . . . 6 . . 9	. . . . 4 5 . . . 9
—— nigra, *Linn.*	 9	 9	. . . .
Diplotaxis tenuifolia, *DC.*	1 2	. 1 2 3 4 5 6 . . 9	. . 2 3 4 . 6 7 8 9
—— muralis, *DC.*	1 2	. . . . 4 . 6 . . .	. . . . . . 6 . . .
—— viminea, *DC.*	1 2	. . . .	. . 2 . . . .
Vesicaria utriculata, *Lam.*	. . . . 8 9	. 1 2	. . . .
Alyssum petræum, *Ard.*	. . . .	. . . .	. . . .
—— medium, *Host*	. . . .	. . . .	. . . .
—— alpestre, *Linn.*	. ? . . 5 6 7 8 .	. . . . . 5 6 . 8 .	. . . .
—— argenteum, *Vitm.*	. . . . 8 9	. . . . 4 5 6 . ? ?	. . . .
—— montanum, *Linn.*	. 2 3 . 5 6 . 8 9	0 . 2 . . . 6 . . .	. . . . 4 . . . . .
—— Wulfenianum, *Bernh.*	. . . .	. . . .	. . . .
—— halimifolium, *Linn.*	1 2 3 4	. . . .	. . . .
—— calycinum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . . 8 9	. . . . 4 5 . 7 8 9
—— campestre, *Linn.*	. . . .	. . . .	. . . .
Farsetia incana, *R. Br.*	. 2 3	. . . . 4 9	. . . . 4 . . . . .
—— clypeata, *R. Br.*	. . . .	. . . .	 9
Lunaria rediviva, *Linn.*	1 2 3 . . . . 8 .	. . . . 4	. . 2 . . . 6 . . .
Petrocallis pyrenaica, *R. Br.*	1 2 . 4 5 6 7 8 9	. . 2 . . 5 6 . . .	. . . . . . 6 . 8 .
Draba aizoides, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	. . . . 4 5 6 7 8 9
—— ——, var. (D. Zahlbruchneri, *Host*)?.	. . . .	. . . 3 . 5 . ? . .	. . . . . 5 . 7 . .
—— Sauteri, *Hoppe*	. . . .	. . . .	. . . .
—— nemoralis, *Ehrh.*	. . . . 8 .	. . . .	. . . .
—— muralis, *Linn.*	. 2	. . . . . . ? . . 9	. . . . 4 . . 7 . .
—— incana, *Linn.*	. . . . 8 .	. . . .	. . . . . 5 . . 8 .
—— tomentosa, *Wahlenb.*	. . . .	. . . .	. . . . . 5 . . 8 .
—— ——, var. (D. frigida, *Saut.*)	1 2 3 4 . . 7 8 9	. 1 . . . 5 6 . . .	. . . 3 . 5 . . 8 .
—— ——, var. (D. Traunsteineri, *Hoppe*).	. . . . 8 .	. . . .	. . . .
—— stellata, *Jacq.*?	. . . .	. . . .	. . 2 . . 5 . . . .
—— ——, var. (D. carinthiaca, *Hoppe*).	1 2 3 . 5 6 . 8 9	. 1 2 3 4 5 6 . 8 .	. . . . . 5 . 7 8 .
—— ——, var. (D. sclerophylla, *Gaud.*).	. . . .	. . . . . . 6 . . .	. . . . . 5 . . . .
—— fladnitzensis, *Wulf.*	. . . .	. . 2 . . 5	. . . . . 5 . . . .
—— verna, *Linn.*	1 2 . 4 5 . . 8 9	. . . . . . 6 . 8 9	. . 2 . 4 5 6 7 8 .
Cochlearia officinalis, *Linn.*	1	. . . .	. . . .
—— saxatilis, *Lam.*	1 2 3 4 . 6 7 8 9	0 1 2 . . . 6 . 8 .	0 . 2 . . 5 6 7 8 9
—— brevicaulis, *Facch.*	. . . .	. . . .	. . . .

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . . 4 5 6 7 8 9	0 . . 3 . . . 7 . .	.	F A G I L C N P S K	Sisymbrium Sophia.
. . . .	. . . .	.	F A . . . . . P . K	—— pinnatifidum.
. . . . . . 6 7 . .	. . . .	.	F A G . . . . . . K	—— strictissimum.
0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 . . 7 . 9	50	F A G I L C N P S K	—— Alliaria.
0 1 2 3 4 5 . 7 8 .	0 1 2 3 4 5 . 7 . .	50	F A G I L C N P S K	—— Thalianum.
. . . .	. . . .	.	F A . . . . . P . .	Hugueninia tanacetifolia.
. . . .	. . . 3 . . . . 8 .	.	F A G I . . . P S K	Erysimum cheiranthoides.
. . . .	. . . .	.	F A . I . . . . S K	—— virgatum.
. . . .	. . . . 7 8 .	.	. . G I . . . . . K	—— odoratum.
. . . .	. . . . 7 8 .	.	. . . I . . . . . K	—— repandum.
. . . . 7 . .	. . . 3	.	F A . I L C ? P . K	—— canescens.
. . . 3 . 5 . 7 8 .	. . . 3	.	. . G	—— rhæticum.
. . 2 . 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	.	F A G I L C N P . K	—— Cheiranthus.
. . . .	. . . .	.	F A G . L . . P . K	—— ——, var. (E. pumilum).
. . . . . 5 . 7 8 .	. . . .	.	. A G I . ?	—— ——, var. (E. helveticum).
. . . .	0	50	? A G I L C N ? . K	—— orientale.
. . . .	. . . .	.	F A . . . C . P . .	Brassica Cheiranthus.
. . 2 . . 5	. . . .	.	F A ? . . C . P . .	—— obtusangula.
. . . .	. . . .	.	F	—— repanda.
. . . .	. . . .	.	F	—— Richerii.
. 1 2 . 4 5 . 7 8 .	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Sinapis arvensis.
. . . . 4 5	. . . .	.	F A G I L C N P S K	—— nigra.
. 1 2 . 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9	50	F A G I L C N P S K	Diplotaxis tenuifolia.
. . 2 . . 5 . 7 . .	. . . 3 4	50	F A G I L C N P . K	—— muralis.
. . . .	0	.	. ? . I . C N P . .	—— viminea.
. . . .	. . . .	.	F A . I ? C N . . .	Vesicaria utriculata.
. . . .	. . . . 7 8 9	50	. . . . K	Alyssum petræum.
. . . .	. . . . 7 . .	.	. . . I	—— medium.
. . . .	. . . ?	.	F A . . . . . P . K	—— alpestre.
. . . .	. . . .	.	. . . I L C . . . K	—— argenteum.
. . . . 7 . .	0	50	F . . I L C N P . K	—— montanum.
. . . .	. . . . 4 9	50	. . G I . . . . . K	—— Wulfenianum.
. . . .	. . . .	.	F	—— halimifolium.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— calycinum.
. . . .	. . . .	50	F . . I . C N P . K	—— campestre.
. . . . . 5 6 7 8 .	. . . .	.	? . G I L . . . S K	Farsetia incana.
. . . . . 5	0	.	. . . I . C	—— clypeata.
. . . . 4	0 . 2 3 . . . 7 . .	50	F A G I L C N P S K	Lunaria rediviva.
. . 2 3 4	. 1 2 3 4 . . 7 . 9	50	F A G I L . . P . K	Petrocallis pyrenaica.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	.	F A G I L C N P . K	Draba aizoides.
. . . . 7 . 9	 9	.	. A G	—— ——, var. (D. Zahlbruchneri) ?
. . . . 8 9	. . . 3	.	. . G	—— Sauteri.
. . . .	. . . .	.	. . . . P S K	—— nemoralis.
. . . .	0	.	F . . I L C N P S K	—— muralis.
. . . . 7 8 9	. . . . 4 5	.	F A G . . . . P S .	—— incana.
. . . . 8 .	. . . . 4 5	.	F A G I . . . P . K	—— tomentosa.
. . 2 . . . . 7 8 9	. . . 3 4 5	.	F A G I . . . . . K	—— ——, var. (D. frigida).
. . . . . 5 . . 8 9	. . . .	.	. . G	—— ——, var. (D. Traunsteineri).
. . . 3 4 . . 7 . .	. . 2 3	.	. A G . . . . . S ?	—— stellata.
. . . . . . 6 7 8 9	. . . 3 4 . . 7 . .	.	F A G . . . . . S ?	—— ——, var. (D. carinthiaca).
. . . . . . 6 . . .	. . . .	.	. A	—— ——, var. (D. sclerophylla).
. . . . 7 8 9	. . . . 7 . .	.	F A G I . . . . S ?	—— fladnitzensis.
. 1 2 3 4 5 . . 8 .	0 1 2 3 . 5 . 7 8 .	50	F A G I L C N P S K	—— verna.
. . . .	. . . .	.	. A . . . . . P S K	Cochlearia officinalis.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— saxatilis.
. . . . 8 9	. . . . 4	.	. . . .	—— brevicaulis.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Camelina sativa, *Crantz*	. . . 4 . . 7 . .	. . 2 3 4	. . . . 4 . . . . .
—— dentata, *Pers.*	. . . .	. . . .	. . . . . 5 . . . .
Thlaspi arvense, *Linn.*	1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 .	. . 2 . 4 5 . 7 8 .
—— alliaceum, *Linn.*	. . . . . 6 . . .	. . . . . . ? . . ?	. . . . 8 .
—— perfoliatum, *Linn.*	1 2 . . . . . 8 .	. . . . . . 6 . . 9	. . 2 . . . 6 . . 9
—— alpestre, *Linn.*	1 2 3 . . . 7 8 .	. . 2 . . 5	. . . . 4 5 . . . .
—— virgatum, *Gren. et Godr.*	. . 3 . 5 6 7 . .	. . . .	. . . .
—— præcox, *Wulf.*	. . . .	. . . .	. . . . 8 .
—— alpinum, *Jacq.*	. . . 4 5 6 . . .	. . . . . 5 6 7 . .	. . . .
—— montanum, *Linn.*	. . . . 8 9	. . . . . . 6 . . .	. 1 . . 4 5 . . . .
—— rotundifolium, *Gaud.*	1 2 3 . 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	. . 2 . 4 5 6 7 8 .
—— ——, var. (T. cepeæfolium, *Koch*)	1 2 3 . . . 7 8 .	. . . . . 5 6 . . .	. . . . ? . .
Iberis saxatilis, *Linn.*	. 2 . . . 6 7 8 .	. . . . . . ? . ? .	. . . .
—— ciliata, *All.*	1 2	. . . .	. . . .
—— nana, *All.*	. 2	. . . .	. . . .
—— Garrexiana, *All.*	1 2 . 4	. . . .	. . . .
—— pinnata, *Gouan*	. 2 . 4 . . . 8 9	. . . .	. . . .
Biscutella auriculata, *Linn.*	1 2 . . . . . 8 .	. . . .	. . 2 . . . .
—— ——, var. (B. cichoriifolia, *Lois.*)	1 2	. . . .	. . . .
—— lævigata, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (B. saxatilis, *Schleich.*)	. . . 4 . . 7 . .	. . . .	. . . . 4 . 6 7 8 .
Lepidium campestre, *R. Br.*	1 2 . 4 . . 7 8 .	. . . 3 4	. . . . 4 . . . 8 9
—— ruderale, *Linn.*	. 2 . . . . . 8 .	. . . .	. . 2 . . . 6 . . .
—— graminifolium, *Linn.*	1 2 . . . . . 8 9	. 1 . . . . 6 7 8 9	. . 2 . 4 5 6 7 8 .
Hutchinsia alpina, *R. Br.*	1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 6 7 8 9
—— ——, var. (H. brevicaulis, *Hoppe*).	. . 3	. . 2	. . . . . 5 . . . .
—— petræa, *R. Br.*	1 2 . . . . . 8 .	. . . . 4 . ? . 8 .	. . . . . 5 . . . .
—— pauciflora, *Nym.*	. . . .	. . . .	. . . . . 5 . . . .
Capsella Bursa-pastoris, *Moench*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Æthionema saxatile, *R. Br.*	1 2 3 . 5 . 7 8 9	. . . .	. . 2 . . 5 6 7 8 .
—— Thomasianum, *Gay*	. . . .	. . 2	. . . .
Coronopus Ruellii, *All.*	. . . . 8 .	. . . .	. . . . 7 8 .
Isatis tinctoria, *Linn.*	1 2 3 4 5 . . 8 .	. . . 3 4	. . . .
—— ——, var. (I. præcox, *Wldst. & Kit.*)	. . . .	. . . .	. . . . 8 .
—— alpina, *All.*	. . . 4 5	. . . .	. . . .
Calepina Corvini, *Desv.*	1 . . . . . . 8 .	. . . . ?	. . . .
Neslia paniculata, *Desv.*	1 2 . . . . . 8 .	. . . . . 5 . 7 . .	. . 2 . 4 5 . 7 8 .
Myagrum perfoliatum, *Linn.*	. . . . 8 .	. . . .	. . 2 . . . 6 . 8 .
Bunias Erucago, *Linn.*	1	. . . . . . 6 . . 9	 9
—— ——, var. (B. arvensis, *Jord.*)	. . . . . 6 . . .	. . . .	. . . .
Rapistrum rugosum, *All.*	1 2 . . 5 . . 8 .	. . . .	. . . 3 . . . . . .
Capparis spinosa, *Linn.*	. . . . 8 .	 9	. . 2 . . . .
—— ——, var. (C. ovata, *Desf.*)	. . . .	. . . .	. . . .
Cistus salvifolius, *Linn.*	1 . . . . . . 8 .	 9	0 . . 3 . . 6 . 8 .
—— albidus, *Linn.*	. . . .	. . . .	. . . .
Helianthemum guttatum, *Vill.*	. . . . 8 .	. . . .	. . 2 . . . .
—— lunulatum, *Coll.*	. 2	. . . .	. . . .
—— Fumana, *Mill.*	1 2 3 4 . . 7 8 .	. . . . 4 5 . . . 9	. . 2 . 4 5 6 7 8 9
—— salicifolium, *Pers.*	1 . . . . . . 8 .	. . . .	. . . .
—— italicum, *Pers.*	1 2 3 4 5 6 7 8 9	0 . 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— marifolium, *DC.*	. . . . . . 7 . .	. . . . 4	. . 2 . 4 . . 7 . 9
—— vulgare, *Gærtn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— polifolium, *Pers.*	1 2 3 4 . . 7 8 .	. . . .	0 . 2 . . . 6 . 8 .
Viola pinnata, *Linn.*	. . . . . 6 7 8 .	. . 2 . . 5	. . . . . 5 . . . .
—— palustris, *Linn.*	. 2 3 4 . 6 . 8 .	. 1 2 3 4 5 6 7 8 9	0 1 . . 4 5 . . 8 .
—— hirta, *Linn.*	. 2 3 . . . 7 8 9	0 1 . . . . 6 . 8 9	0 . 2 3 4 . . 7 8 .
—— ——, var. (V. sciaphila, *Koch*)	. . . . . 6 . . .	. . . .	. . . .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . . . 5 6 . 8 9	0 . . . . 5 . 7 . .	.	F ? G ? L C N P S K	Camelina sativa.
. . . . 9	. . . 3 . . . 7 . .	.	? A G I . . . ? S K	—— dentata.
0 . 2 3 4 5 6 7 8 9	0 1 2 . 4 5 . 7 . .	50	F A G I L C N P S K	Thlaspi arvense.
. . . .	. . . .	50	. . G I . C N . . K	—— alliaceum.
. . . 3 4 5 6 . . 9	0 1 . 3	.	F A G I L C N P S K	—— perfoliatum.
. . 2 . 4	. . . 3	.	F A G ? L C N P S K	—— alpestre.
. . . .	. . . .	.	F . . . . . . P . .	—— virgatum.
. . . . 4	0 1 2 3 4 . . 7 8 9	50	. . . I . . . . . K	—— præcox.
. . . .	. . . . 4 5 . 7 . .	.	F A G I . . . . . K	—— alpinum.
. . . .	. 1 . 3 . . 6 . . .	.	F A . I . . . . S K	—— montanum.
0 . 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 . 9	.	F A G I . . . . . K	—— rotundifolium.
. . . . 4	0 1 . . . 5 6 7 . 9	.	. . G I	—— ——, var. (T. cepeæfolium).
. . . .	. . . .	.	F A . . . C N . . .	Iberis saxatilis.
. . . .	. . . .	.	F . . . L . . P . .	—— ciliata.
. . . .	. . . .	.	F . . . L . . P . .	—— nana.
. . . .	. . . .	.	F . . I L C N P . .	—— Garrexiana.
. . . .	. . . .	.	F ? . I L C . P . .	—— pinnata.
. . . .	. . . .	.	F	Biscutella auriculata.
. . . .	. . . .	.	F . . I . C . P . .	—— ——, var. (B. cichoriifolia).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— lævigata.
. . . . 4	0 . . 3	.	F A G I L C N P . ?	—— ——, var. (B. saxatilis).
. . 2 . 4 . . . 8 9	0	50	F A G I L C N ? S K	Lepidium campestre.
. . . . . 5 . 7 8 .	0 . . 3	50	F A G I L ? N P S K	—— ruderale.
. 1 2 . 4 5 . 7 8 .	0 . . 3	50	F A . I L C N P . K	—— graminifolium.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	.	F A G I L C N P . K	Hutchinsia alpina.
. . 2 3 4 . 6 7 8 .	. . . 3 . 5 . 7 . 9	.	. . G I . . . . . K	—— ——, var. (H. brevicaulis).
. . 2 . 4 5 6 . . .	 9	.	F A G I ? C N P S K	—— petræa.
0 1 . . . 5 . 7 8 9	. . . 3 4	.	. . . .	—— pauciflora.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Capsella Bursa-pastoris.
0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I ? C N P . K	Æthionema saxatile.
. . . .	. . . .	.	. . . .	—— Thomasianum.
. 1	0	50	F A G I L C N P S K	Coronopus Ruellii.
. . . . 8 .	0 . . 3	.	? A G I L C N ? S K	Isatis tinctoria.
. . . .	. . . .	.	. . . I . . . . . ?	—— ——, var. (I. præcox).
. . . .	. . . .	.	F . . . . . N . . .	—— alpina.
. . . .	. . . .	.	? A . I L C N P . K	Calepina Corvini.
. . 2 . 4 5 . 7 8 9	0 1 2 3 . 5 . . 8 .	.	F A G I L C N P S K	Neslia paniculata.
. . . . 4	. . . .	.	F A . I . C N P . K	Myagrum perfoliatum.
. . . . 4	0 1 . 3	.	F A G I L C N P . K	Bunias Erucago.
. . . .	. . . .	.	? A . I . . . P . .	—— ——, var. (B. arvensis).
. 1 2 . 4 5 . . 8 .	0 . . 3	.	F A . I L C N P . K	Rapistrum rugosum.
. . 2 . 4 5	0 1 . . . . . . 8 .	.	. . . I L C ? . . .	Capparis spinosa.
. 1 . . . . . . 8 .	. . . .	.	. . . .	—— ——, var. (C. ovata).
. . . .	. . . .	.	. . . I L C N P . .	Cistus salvifolius.
. . . . 4	. . . .	.	. . . . L C . P . .	—— albidus.
. . . .	0	.	. . . I L C N P . .	Helianthemum guttatum.
. . . .	. . . .	.	. . . . L	—— lunulatum.
0 1 2 . 4 5 6 7 8 9	0 1 . 3 4 . . 7 . .	50	F A G I L C N P S K	—— Fumana.
. . . .	0	.	. A . I L C N . . .	—— salicifolium.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P S K	—— italicum.
. 1 2 . 4 5 6 . . .	0 1 . 3	50	F A G I L C N P . ?	—— marifolium.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— vulgare.
. 1 2 . 4 5 6 . 8 .	0 . . 3 . . . 7 . .	.	F . . . L C N P . .	—— polifolium.
. . . . 4 5 . 7 8 9	. . . 3 4 5	.	F A G I	Viola pinnata.
0 . . 3 . . . 7 8 9	. . . 3 4 5 . 7 . .	.	F A G I ? ? ? P S K	—— palustris.
0 . . 3 4 5 . 7 8 9	. 1 2 3 4 5 . 7 . .	50	F A G I ? ? ? P S K	—— hirta.
. . . . 7 8 .	. . . 3	.	. A G	—— ——, var. (V. sciaphila).

	0 (1 2 3 4 5 6 7 8 9)	1 (0 1 2 3 4 5 6 7 8 9)	2 (0 1 2 3 4 5 6 7 8 9)
Viola ambigua, *Waldst. & Kit.*?	. . . . . 6 . . .	. . . .	. . . . 8 .
—— collina, *Bess.*	. . . . . 6 . . .	. . . .	. . . .
—— odorata, *Linn.*	1 2 3 4 5 . . 8 9	. . . . . . 6 . 8 9	. . 2 . 4 . 6 7 8 9
—— ——, var. (V. alba, *Bess.*)	. . . . . 6 . . .	. . . .	. . . . 8 .
—— suavis, *Bieb.*	. . . .	. . . .	. . . .
—— sylvestris, *Lam.*	1 2 . . . 6 . 8 9	. . 2 . 4 5 6 7 8 .	0 . . . . 5 . 7 8 9
—— —— var. (V. arenaria, *DC.*)	1 2 . . . 6 7 8 .	. . . . . . 6 . . .	. . . . 4 . . . 8 .
—— canina, *Linn.*?	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (V. Ruppii, *Reichb.*)	. . 3 . . 6 . . .	. . . .	. . . . 8 .
—— elatior, *Fr.*?	1 . . . . . . 8 .	 9	. . 2 . 4 . . . . .
—— mirabilis, *Linn.*	. . . . . 6 . 8 9	. . . .	. . . . 4 . . . . .
—— nummulariæfolia, *All.*	1 2 3	. . . .	. . . .
—— ——, var. (V. Comollia, *Mess.*)	. . . .	. . . .	. . . . 4 . . 7 8 .
—— biflora, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— calcarata, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	. 1 . 3 4 5 6 . 8 9
—— cenisia, *Linn.*	1 2 3 . . 6 . 8 .	. . 2 . . . 6 7 8 .	. . . .
—— ——, var. (V. valderia, *All.*)	1 . 3 4	. . . .	. . . .
—— lutea, *Linn.*?	. . . .	. . . .	. . . .
—— declinata, *Waldst. & Kit.*	. . . .	. . . .	. . . . 4 . 6 7 8 9
—— rothomagensis, *Desf.*	. . . . 8 .	. . . .	. . . .
—— tricolor, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (V. arvensis, *Murr.*)	. . . 4	. . 2 3 4 . . . 8 9	0 1 2 3 4 5 6 7 8 .
—— ——, var. (V. saxatilis, *Schmidt*)	1 2 . 4 . . . 8 .	. 1 . . . . 6 7 . 9	. 1 . 3 4 5 . . . .
Reseda Phyteuma, *Linn.*	1 2 . 4 . . . 8 .	. . . .	. . . .
—— lutea, *Linn.*	1 2 3 4 5 6 7 8 .	. . 2 3 4 5 . . . 9	. . 2 . . . . . 8 .
—— suffruticulosa, *Linn.*	. . . .	. . . .	. . . .
—— luteola, *Linn.*	. . . . 5	. . . 3 . . 6 . . 9	. . . . 4 5 . 7 8 .
Polygala nicæensis, *Risso*	1 2	. . . .	. . 2 . . . 6 . 8 .
—— vulgaris, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— comosa, *Schk.*	1 . . . . 6 . . .	. . . .	. . 2 . . . 6 . 8 .
—— depressa, *Wender.*	. . . . . 6 . . .	. . . 3	. . . . 8 .
—— calcarea, *Schultz*	. . . . . 6 . . .	. . . .	. . . . . . 6 . . .
—— amara, *Linn.*	. 2 . 4 5 6 7 8 9	. 1 2 . 4 5 6 . . .	0 . 2 . 4 5 6 7 8 .
—— ——, var. (P. austriaca, *Reichb.*)	1 . . . 5	. . . .	. 1 . . 4 . . 7 . .
—— Chamæbuxus, *Linn.*	1 2 3 4 . . . 8 .	. . 2 . . . 6 . 8 9	0 1 2 . 4 5 6 7 8 9
—— Morisiana, *Reichb.*	. 2	. , ...	. . . .
Drosera rotundifolia, *Linn.*	. . . . 8 .	. . . . 4 . 6 . . 9	0 . 2 . . . 6 7 8 .
—— longifolia, *Linn.*	. . . . 8 .	. . . . 4 9	. . 2 . . . . 7 . .
Aldrovanda vesiculosa, *Linn.*	. . . .	. . . . 4 . 6 . . .	. . . .
Parnassia palustris, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Gypsophila fastigiata, *Linn.*	. . . .	. . . .	. . . .
—— repens, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— muralis, *Linn.*	. . . . 8 .	. . . . . . 6 . . 9	. 1 2 . 4 . 6 . . .
Tunica Saxifraga, *Scop.*	1 2 3 4 . 6 7 8 9	0 1 . 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Dianthus prolifer, *Linn.*	1 2 3 4 5 6 7 8 .	. . 2 3 4 5 6 . 8 9	0 . 2 3 4 5 6 7 8 9
—— Armeria, *Linn.*	. . . . . . 7 8 9	. . . . . . 6 . . 9	. . 2 . 4 . . . 8 .
—— barbatus, *Linn.*	. . . .	. . . .	. . . . 4 . . . . .
—— Carthusianorum, *Linn.*	. 2 . . . . . 8 .	0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— atrorubens, *All.*	1 2 3 . 5 6 7 8 9	0 1 2 . 4 5 6 . . 9	0 1 2 3 4 5 6 7 8 9
—— Seguieri, *Vill.*	1 2 3 4 5 6 . 8 9	0 . 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— liburnicus, *Bartl.*	. 2	. . . .	. . . .
—— neglectus, *Lois.*	1 2 3 4 5 6 7 8 9	. . . . . . ? ? . .	. . . . ? . . . . .
—— ——, var. (D. tener, *Balb.*)?	1 2 . . 5 6 . . .	. . . .	. . . .
—— glacialis, *Haenke*	. . . .	. . . .	. . . . 4 5 . . 8 .
—— alpestris, *Balb.*	1 2 3 . ? ? . . .	. . . .	. . . .
—— ——, var. furcatus, *Bert.*	. . . .	. . . .	. . . .
—— deltoides, *Linn.*	1 2 3 . . 6 . . .	. . . .	. . . . ? . . . . .
—— sylvestris, *Wulf.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . .	. . . .	.	? A . . . . K	Viola ambigua.
. . . . 7 8 .	. . . 3	.	F A G I . . . . S K	—— collina.
0 1 2 ? 4 5 6 7 8 9	0 1 . 3 . 5 . 7 8 9	50	F A G I L C N P S K	—— odorata.
. . . .	. . . . 7 . .	.	F . . I . . . . . K	—— ——, var. (V. alba).
. . 2 . 4 5 6 7 8 .	. . . .	.	F A G . . . . . S K	—— suavis.
. . 2 3 . 5 6 7 8 9	. 1 . 3 . . . . 8 .	50	F A G I L C N P S K	—— sylvestris.
. . . . 4 5 6 7 8 9	. . 2 . 4	.	F A G I . . . . S K	—— ——, var. (V. arenaria).
0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— canina.
. . . . . 5 . 7 8 .	0 . . 3	.	. . . . L C	—— ——, var. (V. Ruppii).
. . . . 4 5	0 . . 3	.	F . . . L ? . . S K	—— elatior.
. . 2 . 4 5 . 7 8 .	0 . . 3 . . . 7 8 .	.	F A G I . C . . S K	—— mirabilis.
. . . .	. . . .	.	?	—— nummulariæfolia.
. . . .	. . . .	.	. . . .	—— ——, var. (V. Comollia).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	.	F A G I L C ? P S K	—— biflora.
. . . . 7 . .	. . . .	50	F A G I L C N . . K	—— calcarata.
. . . . . ?	. . . .	.	F A . . . . N P . K	—— cenisia.
0 . 2	. . . .	.	. . . . P . .	—— ——, var. (V. valderia).
. . . . . . 6 7 8 .	. . . .	.	F A G . ? ? N P . ?	—— lutea.
. 1 2	. . . .	.	. . ? . L C . . . K	—— declinata.
. . . .	. . . .	.	. . . .	—— rothomagensis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . . . 9	.	F A G I L C N P S K	—— tricolor.
. . 2 3 4 5 6 . 8 .	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P . K	—— ——, var. (V. arvensis).
0 . . 3 4 . 6 7 8 9	. . 2 . 4 5 . 7 . 9	.	F A G . . . . P S ?	—— ——, var. (V. saxatilis).
0 1 . . 4	0	.	F A . I L C N P . ?	Reseda Phyteuma.
0 1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A . I L C N P . ?	—— lutea.
. . . . 4	. . . .	.	. . . ? L C N ? . ?	—— suffruticulosa.
. . . . 7 8 .	. . . 3	.	F A G I L C N P S K	—— luteola.
. 1	. . . .	.	? . . I L C N . . ?	Polygala nicæensis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— vulgaris.
. 1 . 3 . . 6 7 8 .	. . . 3	.	F A G . . . . P S K	—— comosa.
. . . .	. . . .	.	F ? G . . . . P S .	—— depressa.
. . . .	. . . .	.	F . . ? . . ? P . K	—— calcarea.
. . . . 4 5 . . 8 9	0 1 2 3 4 5 . 7 . 9	50	? A G I L C N P . K	—— amara.
. . . . 7 8 .	 9	.	F A G ? . . . ? . K	—— ——, var. (P. austriaca).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C . . . K	—— Chamæbuxus.
. . . .	. . . .	.	. . . .	—— Morisiana.
. . . 3 4 5 6 . 8 .	. . 2 3 . . . 7 . .	50	F A G ? L C ? P S K	Drosera rotundifolia.
. . . 3 . 5 . . 8 .	. . . 3 . . . 7 . .	50	F A G . . C . P S K	—— longifolia.
. . . . . 5	0	.	. A . . . C . P . .	Aldrovanda vesiculosa.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	.	F A G I L C N P S K	Parnassia palustris.
. . . .	. . . . . . 6 . . .	.	. . . ? . . . . S K	Gypsophila fastigiata.
0 . 2 3 4 5 . 7 8 9	. 1 2 3 4 5 . 7 8 9	50	F A G I L C . P . K	—— repens.
. . . . . 5 . . 8 .	. . . .	.	F ? G I . . . P S K	—— muralis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	Tunica Saxifraga.
. . . . 4 5 6 7 8 .	0 1 . 3	50	F A ? I L C N P S K	Dianthus prolifer.
. . . . . 5 . 7 . .	0 1 . 3 . . . . 8 .	.	F A ? I L C N P S K	—— Armeria.
. . . . 8 9	. . . 3 . . . 7 . .	50	. . G I . C N P . K	—— barbatus.
. . . 3 4 5 6 7 8 .	0 1 . 3 . . 6 . . .	50	F A G I L C N P . K	—— Carthusianorum.
. 1 2 3 4 5 6 7 8 .	0 1 . 3 . . . 7 8 9	50	F A . . L . . ? . K	—— atrorubens.
. . 2 3 4 5 6 7 8 9	. 1 . 3	50	F A G I L C ? P S K	—— Seguieri.
. . . .	. . . .	.	. . . I L . ? . . .	—— liburnicus.
. . . .	. . . .	.	F A . . L . . P . K	—— neglectus.
. . . .	. . . .	.	. . . . P . .	—— ——, var. (D. tener).
. . . . . . 6 7 8 .	. . . . 7 . .	.	. A G ? . . . . . K	—— glacialis.
. . . .	. . . .	.	. . . I L	—— alpestris.
. . . .	. . . .	.	. . . . ? . .	—— ——, var. furcatus.
. . . . 7 . .	. . . 3	50	F A G I ? C N P S K	—— deltoides.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— sylvestris.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Dianthus cæsius, *Sm.*	. . . .	. . . . 8 .	. . . .
—— plumarius, *Linn.*	. . . . ? .	. . . . ?	. 1 2 . . . . . 8 .
—— superbus, *Linn.*	. . . 4 . 6 . . 9	. . . . . . 6 7 8 9	. 1 2 . . 5 6 . 8 .
—— oreades, *nobis*	. . . .	. . . .	. . . . . . 6 . . .
—— monspessulanus, *Linn.*	1 2	0 . . . . . 6 . . .	. . 2 3 . . 6 7 8 .
—— hirtus, *Vill.*	. 2	. . . .	. . . .
Saponaria Vaccaria, *Linn.*	. . . . 8 .	. . 2 . . . . . 8 9	. . . . 4 . . 7 . .
—— officinalis, *Linn.*	1 2 3 4 5 6 7 8 9	. 1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ocymoides, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 . 4 . 6 7 8 9	. 1 2 3 4 5 6 7 8 9
—— lutea, *Linn.*	1 . . . . 6 7 8 .	. . 2 . 4 5 6 . . .	. . . .
Cucubalus baccifer, *Linn.*	. . . . 5 . . 8 9	. . . . . . 6 . . 9	. . 2 . 4 5 . 7 8 .
Silene gallica, *Linn.*	1 2	. . . .	. . 2 . . . .
—— ——, var. (S. glandulosa, *Bert.*)	. . . .	. . . .	. . . .
—— italica, *Linn.*	1 2 3 4 . . . 8 .	. 1 9	. . 2 . . . 6 . 8 9
—— nemoralis, *Waldst. & Kit.*	. . . .	. . . .	. . . .
—— nutans, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— paradoxa, *Linn.*	. . . .	. . . .	. . . .
—— Otites, *Sm.*	1 2 3 4 . . . 8 9	. 1 2 . 4 5 6 7 8 9	0 1 2 . 4 5 . 7 8 .
—— inflata, *Sm.*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. angustifolia, *Koch*	. . . .	. . . .	. . . . . . 6 . . .
—— ——, var. alpina, *Koch*	1 . . . 5 . 7 8 9	. . 2 . 4 5 6 . . .	. . . . 4 5 . 7 . .
—— Pumilio, *Wulf.*	. . . .	. . . .	. . . .
—— Elizabethæ, *Jan*	. . . .	. . . .	. . . . . . 6 . . 9
—— cordifolia, *All.*	1 2 3	. . . .	. . . .
—— conica, *Linn.*	. . . . 8 .	. . . .	. . . .
—— noctiflora, *Linn.*	. . . .	. . . .	. . . . 4 5 . . . .
—— vallesia, *Linn.*	. . . 4 5 6 7 8 9	0 1 2 3 4 5 6 . . .	. . . . ?
—— Armeria, *Linn.*	1 2 3 4 . . . 8 9	0 . . . . . 6 7 . 9	. . 2 . 4 . 6 . 8 .
—— linicola, *Gmel.*	. . . .	. . . .	. . . .
—— cretica, *Linn.*	. . . .	. . . .	. . . .
—— inaperta, *Linn.*	. . 3	. . . .	. . . .
—— Campanula, *Pers.*	. 2 3	. . . .	. . . .
—— Saxifraga, *Linn.*	1 2 3 4 5 . 7 8 9	0 . . . . 5 6 . 8 9	. . 2 . 4 5 6 7 8 9
—— quadrifida, *Linn.*	. 2 . 4 . . 7 8 9	0 . . . . 8 9	. 1 2 3 4 5 6 . . 9
—— alpestris, *Jacq.*	. . . .	. . . .	. . . .
—— rupestris, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— acaulis, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— exscapa, *All.*	1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 .	0 . . 3 4 5 . . . .
Lychnis viscaria, *Linn.*	1 2 . . . . . 8 9	. . . . . . 6 7 . 9	. . 2 . . . .
—— alpina, *Linn.*	. . . . 8 .	0 1 2 . . 5 6 . . .	. . . . 4 . 6 7 8 .
—— Flos-cuculi, *Linn.*	1 2 3 4 . . 7 8 9	0 . 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 .
Agrostemma Githago, *Linn.*	1 2 . 4 5 . . 8 9	0 . . 3 4 . 6 . 8 9	. . 2 . 4 5 6 . . 9
—— coronaria, *Linn.*	. . . .	. . . . 4	. . . .
—— Flos-Jovis, *Linn.*	1 2 3 . . . 7 8 .	0 . 2 . . . 6 . 8 .	. . 2 . 4 . . . 8 9
Melandrium pratense, *Roehl.*	1 2 3 4 5 . 7 8 .	0 . 2 . 4 . 6 7 8 9	0 1 2 3 4 5 . 7 8 9
—— sylvestre, *Roehl.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Buffonia tenuifolia, *Linn.*	. 2 . . . . 7 . .	. . . .	. . . .
Sagina procumbens, *Linn.*	1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .
—— bryoides, *Froel.*	. . . .	. . . .	. . . . . 5 . . . .
—— apetala, *Linn.*	1 2 . . . . . 8 9	. . . . . . 6 . . 9	. . . . 7 8 .
—— ciliata, *Fr.*?	. . . .	. . . .	. . . . 7 . .
—— saxatilis, *Wimm.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .
—— ——, var. (S. macrocarpa, *Maly*)	. . . .	. 1 . . . 5 6 . 8 .	0 1 . 3 4 5 . . . .
—— subulata, *Wimm.*	. . 3 4	. 1 . . . . . 7 . 9	. 1 . . 4 5 . . 8 .
—— glabra, *Koch*	1 2 3 4 5 6 7 8 9	0 1 . . . . 6 . 8 .	. . . . 8 .
—— nodosa, *E. Mey.*	. . . .	. . . .	. . . .
Spergula arvensis, *Linn.*	1 . . 4 . . . 8 9	0 . . . . . 6 7 8 9	. . 2 3 4 5 6 7 8 .
—— pentandra, *Linn.*	. . . .	. . . .	. . . .
Lepigonum rubrum, *Wahlb.*	. . 3 4 5 . . 8 .	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . .	. . . .	.	F A G . . . . . . ?	Dianthus cæsius.
. . . .	 9	50	. . G . . . . . . K	—— plumarius.
. 1 2 . 4 . . . 8 9	0 . . 3 4 . . 7 8 .	.	F A G ? . . . P S K	—— superbus.
0 . 2 3 4 5 . . . 9	. . 2 3 4 5 . 7 . .	.	. . . I	—— oreades.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	50	F A G I L C N P . K	—— monspessulanus.
. . . .	. . . .	.	F . . . . . . P . .	—— hirtus.
. 1 . . 4 5	0 1 . 3	50	? A G I L C N ? . K	Saponaria Vaccaria.
. 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— officinalis.
0 1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G . L C N P . .	—— ocymoides.
. . . .	. . . .	.	F	—— lutea.
. . . . 4 5 . . 8 .	. . . 3	50	? A G I L C N P . K	Cucubalus baccifer.
. . . . 4	0 1 . 3 4 . . 7 8 .	.	F A ? I L C N P S K	Silene gallica.
. . . .	. . . . . 5	.	. . . .	—— ——, var. (S. glandulosa).
. . . . 4 5	0 1 . 3 . . . . 8 .	50	F . . I L C N P . ?	—— italica.
. . 2 . 4 5	. . . .	.	. . G I . . N . . K	—— nemoralis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— nutans.
. . . .	0	.	F . . . L C N . . .	—— paradoxa.
. . 2 . 4 5 6 7 8 9	0 1 . 3 4 5 . 7 . 9	50	F A G I L C N P . K	—— Otites.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— inflata.
. . . . . 5 . . 8 9	. . . . 4 5 6 . . .	.	. . G I . C N . . .	—— ——, var. angustifolia.
. . . 3 4 . . . 8 9	. 1 . . 4 5	.	F A G I L . N P . .	—— ——, var. alpina.
. . . . . 5 . . 8 9	. . . 3	.	. . G I . . . . . K	—— Pumilio.
. 1	. . . .	.	. . . .	—— Elizabethæ.
. . . .	. . . .	.	. . . . L	—— cordifolia.
. . . .	. . . . . 5	.	? . . I . . . P . K	—— conica.
. . . . . 5	. . 2 . . 5	.	. A ? ? . . . . S K	—— noctiflora.
. . . .	. . . .	.	F . . ? . C	—— vallesia.
0 . 2 3 . 5 6 7 8 .	. 1 . 3 . 5 6 . . .	.	F ? G I L C ? P . K	—— Armeria.
. . . . 8 .	. . 2	.	. . . I	—— linicola.
. . . .	. . . 3 . . . 7 . .	.	. . . I . C N P . .	—— cretica.
. . . .	. . . . 7 . .	.	F . . . . C N P . .	—— inaperta.
. . . .	. . . .	.	. . . . L	—— Campanula.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— Saxifraga.
. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	.	F A G I L C N P . K	—— quadrifida.
. . . 3 4 5 . . . 9	. 1 . 3 4 . . 7 8 9	50	. . G I . . . . . K	—— alpestris.
0 1 2 3 4 5 6 7 8 9	. . 2 3 4 5 6 7 . .	.	F A G ? L C . P S K	—— rupestris.
0 1 2 3 4 5 . 7 8 9	. 1 2 3 4 5 6 7 . 9	.	F A G I L C N P S K	—— acaulis.
0 . . 3 . . 6 . . 9	. . . . 4	.	F A G ? L . . P . ?	—— exscapa.
. . . . . 5 . . 8 .	. . . 3 . . . 7 . .	.	F A G I . . . ? S K	Lychnis viscaria,
. . . . . 5	. . . . 7 . .	.	F A G . . C . P S .	—— alpina.
. 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— Flos-cuculi.
0 1 . 3 4 5 . 7 8 .	0 1 2 3 4 5 6 7 . 9	50	F A G I L C N P S K	Agrostemma Githago.
. . . . . 5 . 7 8 .	. . . 3 . . . . ? .	.	? . G I . C N P . K	—— coronaria.
. . . . 4 5 6 7 . .	. . . .	.	F A . . L . N . . .	—— Flos-Jovis.
0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9	50	F A G I L C N P S K	Melandrium pratense.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— sylvestre.
. . . .	. . . .	.	. A . . . . N ? . .	Buffonia tenuifolia.
0 . 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Sagina procumbens.
. . . . 7 8 .	. . . . 4 . . 7 . .	.	. . G	—— bryoides.
. . . .	. . . 3	.	F A . I L C N P . K	—— apetala.
. . . .	. . . 3	.	. . . . S K	—— ciliata.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	.	F A G I . C . P S K	—— saxatilis.
. . 2 3 . . . . 8 9	. . . 3	.	. A G . . . . . . ?	—— ——, var. (S. macrocarpa).
. . . ?	. 1 . 3 4 . . 7 . .	.	. . G . L C N P S K	—— subulata.
. . . . 4	. . . 3	.	F . . . L C N . . .	—— glabra.
. . . . 8 .	. . . .	.	. . . . ? S K	—— nodosa.
. . . . 4 5 . . 8 9	0 1 . 3 4 . . 7 . .	.	F A G I L C N P S K	Spergula arvensis.
. . . .	. . . 3	.	F . G ? . ? . P S K	—— pentandra.
. . . 3 . 5 6 7 8 .	. 1 . 3 4 5	.	F A G I L C N P S K	Lepigonum rubrum.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Alsine lanceolata, *Mert. & Koch*	1 2 . . 5 6 . 8 .	. . . . 4 . . . 8 .	0 1 . . 4 . 6 . 8 .
—— stricta, *Wahlenb.*	. . . .	. . . . 8 .	. . . .
—— laricifolia, *Wahlenb.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	. 1 2 3 4 5 6 . 8 9
—— Bauhinorum, *Gay*	1 2	. . . .	. . 2 . . . .
—— biflora, *Wahlenb.*	. . . .	. . . .	. . . . . 5 . . . .
—— austriaca, *Mert. & Koch*	. . . .	. . . .	. . . . 8 .
—— Villarsii, *Mert. & Koch*	1 2 3 4 5 6 7 8 9	0 . 2 . . 5 ? . . .	. . . .
—— verna, *Bartl.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (A. Gerardi, *Willd.*)	. . . .	. . . 3 . 5	. . . . 7 8 .
—— recurva, *Wahlenb.*	1 2 3 4 5 6 . . .	. 1 2 3 4 5 6 . 8 9	. 1 2 3 4 5 6 7 8 .
—— graminifolia, *Gmel.*	. . . .	. . . .	. . . .
—— rostrata, *Koch*	1 2 . 4 5 6 7 8 9	. . 2 3 4 5 6 . . .	. . 2 . . 5 . . . .
—— Jacquini, *Koch*	. 2 . 4 . 6 . ? .	. 1 2 3 . 5	. . . . ? . . . . .
—— tenuifolia, *Wahlenb.*	1 2 . . . . . 8 .	. . . . . . 6 . . 9	. . 2 . 4 5 6 7 8 9
Cherleria sedoides, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— imbricata, *Mert. & Koch*	. . . .	. . . .	. . . .
—— ——, var. ciliata, *nobis*	. . . .	. . . . . 5 6 . . .	. . . . . 5 . . ? .
Mœhringia muscosa, *Linn.*	1 . 3 4 . . 7 8 9	0 . 2 . 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— ——, var. (M. sphæroides, *Rchb.*)	. . . .	. . . .	. . . .
—— dasyphylla, *Bruno*	. . . .	. . . .	. . . . . . 6 . 8 9
—— ——, var. (M. sedifolia, *Willd.*)	. 2	. . . .	. . . . . . 6 . . .
—— glaucovirens, *Bert.*	. . . .	. . . .	 9
—— Thomasiana, *Gay*	. . . .	. . . .	. . . . . . 6 . . .
—— polygonoides, *Mert. & Koch*	. . . . . 6 . 8 9	. 1 . 3	. . . . . 5 6 7 8 .
—— ——, var. (M.sphagnoides, *Froel.*)	. . . .	. . . .	. . . .
—— papulosa, *Bert.*	. 2	. . . .	. . . .
—— trinervia, *Clairv.*	1 . 3 4 . . 7 8 9	. . . . 4 . 6 7 8 9	0 . 2 3 . 5 6 7 8 9
Arenaria serpyllifolia, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (A. Marschlinsii, *Koch*)	. . . . ? .	. . . . 4	. . . . . 5 . . . .
—— ciliata, *Linn.*	1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (A. multicaulis, *Linn.*)	. . . .	. . . . . 5 . . 8 .	. . . . . 5 . . . .
—— biflora, *Linn.*	. . . . 8 .	. . 2 3 . 5 6 7 8 .	0 1 2 3 4 5 . . 8 9
—— grandiflora, *All.*	. 2 . . . 6 7 8 .	. . . .	. . . .
—— tetraquetra, *Linn.*	. 2	. . . .	. . . .
Holosteum umbellatum, *Linn.*	. . . . 8 .	. . . .	. . . . 4 . . 7 . .
Stellaria viscida, *Bieb.*	. . . .	. . . .	. . . .
—— cerastoides, *Linn.*	1 . 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 . 7 8 .
—— nemorum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— media, *Vill.*	1 2 3 4 . . . 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— bulbosa, *Wulf.*	. . . .	. . . . . . 6 . . .	. . . .
—— Holostea, *Linn.*	1 2 . . . 6 . 8 9	. . . . . . 6 . . 9	. . 2 . 4 5 6 . 8 .
—— glauca, *With.*	. . . .	. . . .	. . . . 8 .
—— graminea, *Linn.*	. ? 3 4 . . . 8 9	0 . . . . . 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— Friesiana, *Ser.*	. . . .	. . . .	. . . .
—— uliginosa, *Murr.*	1 2 3 . . 6 . 8 9	. . . . . . 6 7 8 9	. . 2 . 4 5 6 . . .
Malachium manticum, *Reichb.*	. . . . . 6 . 8 9	. . . . 4 . . 7 8 9	. . 2 . 4 5 . . 8 .
—— ——, var. quaternellum, *nobis*	. . . . . . 7 . 9	. . . . . . 6 . . ?	. . . .
—— aquaticum, *Fr.*	1	. . . . . 5 6 7 . 9	. 1 2 3 . . 6 . . .
Cerastium glomeratum, *Thuil.*	1 2 . . . . 7 8 9	0	. . 2 . 4 . 6 7 8 .
—— brachypetalum, *Desp.*	. . . 4	. . . .	. 2 . . . . . 7 8 .
—— semidecandrum, *Linn.*	1 2 . . . . . 8 .	0 . . . . . 6 . . 9	. 2 . . . . . 7 8 .
—— ——, var. (C. glutinosum, *Fr.*)	. . . 4	. . . .	 9
—— triviale, *Link*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— campanulatum, *Viv.*	. . . .	. . . .	. . 2 . ? . . 7 8 .
—— sylvaticum, *Waldst. & Kit.*	. . . .	. . . .	. . . . 7 8 .

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . 3 4 . . 7 8 9	. . . 3 4 5 6 . 8 .	.	F . G I ?	Alsine lanceolata.
. . . .	. . . .	.	. A G . . . . . S .	—— stricta.
0 . . . . . 6 7 8 9	0 1 2 3 4 5 . 7 . .	.	F A G I L C . P . K	—— laricifolia.
. 1 2 . 4 5 . 7 . .	. . . 3 4 . 6 7 . 9	.	F A G I ? C N . . K	—— Bauhinorum.
. . . . . 5 . . 8 .	. . . .	.	. A . . . . . . S .	—— biflora.
. . 2 3 4 5 . . 8 9	. . . 3 4 5 . 7 . 9	.	. . G I . . . . . K	—— austriaca.
. . . .	. . . .	.	F ? G	—— Villarsii.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— verna.
. . . .	. . . . . 5 . . . 9	.	F A G I . . . P . .	—— ——, var. (A. Gerardi).
. . . 3 . . 6 7 8 9	. . . 3 . 5 6 7 . .	.	F A G . L . N P . K	—— recurva.
. . . .	. . . 3 4	.	. . . I . . N . . .	—— graminifolia.
. . . . . 5 . 7 . .	. . . 3	.	F A ? . . . . P . .	—— rostrata.
. . 2 . 4 5 6 7 . .	0	.	F A G I . . . P . K	—— Jacquini.
. 1 2 . 4 5	0 1 2 3 . . . 7 . .	.	F A G I L C N P S K	—— tenuifolia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	.	F A G I L . . P . K	Cherleria sedoides.
. . 2 3 . . . . 8 9	. . . . 4 5 . 7 . 9	.	. . G I	—— imbricata.
. . . .	. . . .	.	. . . .	—— ——, var. ciliata.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	Mœhringia muscosa.
. . . .	. . . .	.	. . . .	—— ——, var. (M. sphæroides).
0 1 2 . 4 5	0 . . 3 4 5	.	. . G	—— dasyphylla.
. . 2 . 4	. . . .	.	?	—— ——, var. (M. sedifolia).
0 1	. . . .	.	. . . .	—— glaucovirens.
. . . .	. . . .	.	. . . .	—— Thomasiana.
. 1 2 3 4 5 6 7 8 9	. . . 3 4 5 6 7 . 9	50	F A G I . . . P . K	—— polygonoides.
. . . . 7 8 .	. . . .	.	. . . .	—— ——, var. (M. sphagnoides).
. . . .	. . . .	.	. . . . L ?	—— papulosa.
0 . 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— trinervia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Arenaria serpyllifolia.
. . . . . . 6 7 . .	. . . .	.	? A G	—— ——, var. (A. Marschlinsii).
0 . . 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . .	.	F A G I L C N P S K	—— ciliata.
. . . . . 5 . . 8 .	. . . . . 5	.	F A G . . . . P . K	—— ——, var. (A. multicaulis).
. . . 3 . 5 6 7 8 9	. . . 3 . . . 7 . .	.	F A G . . . ? . . K	—— biflora.
. . . . 9	. . . .	50	F A G I L C N P . K	—— grandiflora.
. . . .	. . . .	.	. . . . P . .	—— tetraquetra.
. . . . 4 5 . 7 8 .	0 1 . 3	.	F A ? I L C ? P S K	Holosteum umbellatum.
. . . .	. . . 3	.	. . . I . . . . . K	Stellaria viscida.
0 . 2 3 . . 6 7 8 9	. . . 3 4 5 . 7 . .	.	F A G I . . N P S K	—— cerastoides.
0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 . 7 8 9	.	F A G I L C N P S K	—— nemorum.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— media.
. . . .	. . . .	.	. . . I	—— bulbosa.
. . . .	0 . . 3	50	F A G I L C N P S K	—— Holostea.
. . . .	. . . .	.	. . ? . . . . . S K	—— glauca.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . .	.	F A G I L C ? P S K	—— graminea.
. . . . . 5 . . 8 9	. . . .	.	. . G . . . . . S .	—— Friesiana.
0 . . 3 . . 6 7 8 9	. 1 . 3 . . . 7 . .	.	F A G I L C N P S K	—— uliginosa.
. . . .	0 1 . 3	.	. . . I L C N . S K	Malachium manticum.
. . . .	. . . .	.	. A . . L C N . . K	—— ——, var. quaternellum.
. . 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 . . .	50	F A G I ? C N P S K	—— aquaticum.
. . . . 4 5 . . 8 .	0 1 . 3 . 5	.	F A G I L C N P S K	Cerastium glomeratum.
0 . . . 4 5 . 7 8 .	0 . . 3	.	F A ? I L C N P S K	—— brachypetalum.
. . 2 . . 5 6 7 8 .	. . . 3	50	F A G I L C N P S K	—— semidecandrum.
0 . . . . 5	. . . 3 . . . 7 . .	50	F . . . . C . P S K	—— ——, var. (C. glutinosum).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— triviale.
. . . .	0	.	. A . I L C N . . .	—— campanulatum.
. . . . . . 6 . . .	. 1 . 3 4 . . 7 8 9	50	. . . I . C ? . . K	—— sylvaticum.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Cerastium latifolium, *Linn.*	1 . . . . 6 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 6 7 8 9
—— ——, var. (C. pedunculatum, *Gaud.*).	. . . .	. 1 2 3 . . 6 7 8 .	0 1 . 3 . 5 . . 8 .
—— alpinum, *Linn.* ?	. ?	. . . 3 . . 6 . . .	. . . 3 4 5 6 7 8 .
—— ovatum, *Hoppe*	. . . .	. . . .	. . . .
—— arvense, *Linn.*	1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .
—— ——, var. (C. strictum, *Haenke*).	. . 3 4 . 6 7 8 9	0 1 2 3 . 5 6 . 8 9	0 1 . 3 . 5 . . . .
—— tomentosum, *Linn.*	. . . .	. . . .	. . . .
—— lineare, *All.*	. . . . . 6 . 8 9	0	. . . .
Elatine major, *A. Br.*	. . . .	. . . .	. . . . 8 .
—— hexandra, *DC.*	. . . .	. . . .	0 . . . .
—— Alsinastrum, *Linn.*	. . . .	. . . .	. . 2 . . . .
Linum gallicum, *Linn.*	1 2 . . 5 . . 8 9	. . . .	. . 2 . . . . . 8 9
—— strictum, *Linn.*	1 2 . . . . . 8 .	. . . .	. . . .
—— flavum, *Linn.*	. . . .	. . . .	. . . .
—— campanulatum, *Linn.*	1	. . . .	. . . .
—— viscosum, *Linn.*	1 2 . . 5	. . . .	. . . . 7 8 .
—— tenuifolium, *Linn.*	1 2 . 4 . . 7 8 9	. 1 9	. . 2 . 4 5 6 7 8 9
—— suffruticosum, *Linn.*	1 2 . 4	. . . .	. . . .
—— narbonense, *Linn.*	1 2	. . . .	. . 2 . . . .
—— perenne, *Linn.*?	. . . . ?	. . . .	. . . . . . 6 . . .
—— alpinum, *Jacq.*	1 2 . 4 . . . 8 9	. 1 . . . . . 7 8 .	. 1 2 . 4 . 6 . . 9
—— ——, var. (L. montanum, *Schleich.*).	. . . . 8 .	. . . .	. . . . . . ? . . .
—— catharticum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Radiola linoides, *Gmel.*	. . . . . 6 . . .	. . . .	. . . .
Malva Alcea, *Linn.*	1 2 3 . . . . 8 .	0 1 2 . 4 5 6 7 . .	0 1 2 3 4 . 6 7 8 .
—— moschata, *Linn.*	1 2 3	. . . .	. . . .
—— sylvestris, *Linn.*	1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— vulgaris, *Fries*	1 2 3 4 . . 7 8 9	. 1 . 3 4 5 6 7 8 9	0 . 2 3 4 5 6 7 8 9
—— borealis, *Wallm.*?	. . . .	. . . .	. . . . 8 .
Althæa officinalis, *Linn.*	. . . . 8 .	. . . .	. . 2 . . . .
—— taurinensis, *DC.*	. . . .	. . . . . . 6 . . .	. . . .
—— hirsuta, *Linn.*	. . . . 8 .	. . . .	. . . .
—— cannabina, *Linn.*	. . . . 8 .	. . . .	. . . . 4 . . . . .
Hibiscus Trionum, *Linn.*	. . . .	. . . .	. . . .
—— pentacarpos, *Linn.*	. . . .	. . . .	. . . .
Tilia grandifolia, *Ehrh.*	. . . . . . 7 8 9	. . . . 4 . 6 . . 9	0 . 2 . 4 . . 7 8 .
—— parvifolia, *Ehrh.*	. . . 4	. . . . 4 5 6 7 . 9	. 1 2 . 4 . 6 7 8 9
Hypericum Androsæmum, *Linn.*	1 2 . . 5 6 . . .	 9	. 1 2 . . . . 7 8 .
—— perforatum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (H. veronense, *Schrank*).	. . . .	. . . .	. . 2 . . . 6 . 8 .
—— humifusum, *Linn.*	. . . . 8 9	0 . . . . . 6 . 8 9	. . 2 . 4 . 6 . 8 .
—— quadrangulum, *Linn.*	. 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9
—— tetrapterum, *Fries*	1 2 . . 5 . 7 8 9	0 1 . . . . 6 7 8 9	0 1 2 3 4 5 6 7 8 .
—— Richeri, *Vill.*	1 2 3 4 5 . 7 8 9	. . . .	. . . .
—— montanum, *Linn.*	1 2 3 4 . . . 8 9	0 . 2 . 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9
—— hirsutum, *Linn.*	1 . . . . . . 8 9	. . . . . . 6 . . .	. . 2 . . . . 7 8 9
—— Coris, *Linn.*	1 2 3 4 . . . 8 .	. . . .	. . . .
Acer Pseudoplatanus, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— platanoides, *Linn.*	. . . . 8 .	. . . .	. . . . 7 . .
—— monspessulanum, *Linn.*	. . . .	. . . .	. . . .
—— campestre, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 . . 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— opulifolium, *Vill.*	. 2 . . . . . 8 .	. . . .	. . . .
Geranium macrorhizum, *Linn.*	. 2 . . . . . 8 .	. . . . . . ? . . .	. . . . 8 9
—— phæum, *Linn.*	1 2 3 4 . . 7 8 .	. 1 . . . 5 6 . . .	0 . . 3 4 . . 7 8 9
—— nodosum, *Linn.*	1 2 3 4 5 6 7 8 9	0 . . . 4 5 6 . 8 9	0 . 2 . 4 . 6 7 8 9
—— sylvaticum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— pratense, *Linn.*	. . . .	. . . . . 5	. . 2 . 4 5 6 7 8 .
—— aconitifolium, *L'Hérit.*	1 . . . . . . 8 .	. . 2 . 4 . 6 . . .	. . . . 4 . . 7 8 .

3: 0 1 2 3 4 5 6 7 8 9	4: 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . .	.	F A G I L ? N P S K	Cerastium latifolium.
. . . . 8 9	. . . . . 5	.	F A	—— ——, var. (C. pedunculatum).
. . . . 4 . . 7 8 9	. . 2 3 . 5	.	F A G ? . . . P S K	—— alpinum.
. . . . 7 . 9	. . . . 4 5 6 7 . 9	.	. . G I . . . . . K	—— ovatum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P S K	—— arvense.
. . 2 3 4 5 6 7 8 9	. . . . 4 5 . . 8 .	.	F A G . L . . P . K	—— ——, var. (C. strictum).
. . . .	. . . . 4	.	. A . I . . N . . K	—— tomentosum.
. . . .	. . . .	.	. . . .	—— lineare.
. . . .	. . . .	.	. . . .	Elatine major.
. . . .	. . . .	.	. . . ? . . . . S K	—— hexandra.
. . . .	. . . .	.	. A G . . . . P S K	—— Alsinastrum.
. . . .	0 . . 3	.	F . . I L C N P . .	Linum gallicum.
. . . .	. . . .	.	. . . I L C N P . .	—— strictum.
. . . . ?	. . . . 8 .	50	. . G I L . N P . K	—— flavum.
. . . .	. . . .	.	. . . ? L C N P . .	—— campanulatum.
. . 2 3 4 5 6 . . 9	. 1 . 3 4 5 6 7 8 9	50	. . G I L C N P . .	—— viscosum.
0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— tenuifolium.
. . . .	. . . .	.	F . . . . . . P . .	—— suffruticosum.
. . . . 4 5	0 . 2 3 4 . . . 8 .	.	F . ? I L . . P . K	—— narbonense.
. . . .	. . . .	.	. . . I . . . . S K	—— perenne.
0 1	. 1 . . 4 . 6 7 . 9	.	F A G I L C N P . K	—— alpinum.
. 1 2 3 4	. . 2 ? 4	.	F A . . L C N P . ?	—— ——, var. (L. montanum).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P S K	—— catharticum.
. . . .	. . . .	.	F A . . L C N ? S K	Radiola linoides.
. . 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P S K	Malva Alcea.
. . . .	. . . . 4	.	F A . I L C N P S .	—— moschata.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— sylvestris.
0 . 2 3 4 5 . 7 8 .	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— vulgaris.
. . . .	. . . .	.	. . . . S K	—— borealis.
. . 2 . 4 5 . 7 . .	0 1 . 3	.	. A G I L C N P . ?	Althæa officinalis.
. . . .	? . . 3	.	. . . .	—— taurinensis.
. 1 . . 4	0	.	F A . I L C N P . .	—— hirsuta.
. 1 2 . 4	0 1	50	. . . I L C N P . K	—— cannabina.
. . . . . 5 . 7 8 9	0 . . 3	50	. . ? I	Hibiscus Trionum.
. . . .	. . . . 7 8 .	.	. . . I . C	—— pentacarpos.
. . 2 . 4 5 6 . . .	0 1 . 3 4 . . 7 . .	.	? A G I L C N . . K	Tilia grandifolia.
0 1 2 3 4 5 6 7 8 .	0 1 . 3 4 . . 7 8 9	50	F A G I L C N P S K	—— parvifolia.
. . . . 4	0 1 . 3 . . . 7 . .	.	F A ? I L C N P . .	Hypericum Androsæmum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	50	F A G I L C N P S K	—— perforatum.
. . . . 4 5 . . 8 .	. . . 3	.	. A . I	—— ——, var. (H. veronense).
. . . . 4	0 1 . 3 . . 6 . . .	.	F A G I L C N P S K	—— humifusum.
. . 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 8 9	50	F A G I . . . P S K	—— quadrangulum.
. . . 3 . 5 6 7 8 9	0 1 . 3 . 5	50	F A G I L C N P S K	—— tetrapterum.
. . . .	. . . .	.	F A . I L C N P . .	—— Richeri.
0 1 2 3 4 5 . . 8 9	0 1 2 3 4 5 6 7 . 9	.	F A G I L C N P S K	—— montanum.
0 . 2 . 4 5 . 7 . 9	0 1 . 3 4 . 6 . . .	.	F A G I L C N P S K	—— hirsutum.
. . . . 4 5	. . . .	.	F A . . L C	—— Coris.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P . K	Acer Pseudoplatanus.
. . . . 4 5	0 1 . . 4 . . 7 . .	.	F A G I . . . P S K	—— platanoides.
. . . . 4	0	.	F . . I . C N . . .	—— monspessulanum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— campestre.
. . . .	. . . .	.	F A . . L C N P . .	—— opulifolium.
. . . . 4	. . 2 3 . . 6 7 8 9	50	. . G I . C . . . K	Geranium macrorhizum.
0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 . 7 8 .	50	F A G I . . . P . K	—— phæum.
0 1 2 . 4 5	0 1 2 3 4 . . 7 . .	50	F A . I L C N P . .	—— nodosum.
0 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 . 9	.	F A G I L C N P S K	—— sylvaticum.
. . . . 4 5 . . 8 .	0 1 . . 4 . . 7 . .	.	. A G I . C . P S K	—— pratense.
. 1	. . . .	.	F A	—— aconitifolium.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Geranium palustre, *Linn.*	. . . . 8 .	. . . .	. . . . 7 8 .
—— sanguineum, *Linn.*	1 2 3 4 . . 7 8 9	. 1 2 . 4 . 6 7 8 9	. 1 2 . 4 5 6 7 8 9
—— argenteum, *Linn.*	. . . .	. . . .	. . . . 7 . .
—— pyrenaicum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . . . . 6 7 8 .
—— pusillum, *Linn.*	. . . . . . 7 . .	. . . . . . 6 . . .	. . . . . 5 6 . . .
—— bohemicum, *Linn*	. . . .	. . . .	. . . .
—— dissectum, *Linn.*	1 2 . . . 6 . 8 .	. . . . . . 6 . . 9	. . . . . 5 . 7 8 9
—— columbinum, *Linn.*	1 2 . 4 . 6 . 8 .	. . . . . 5 6 7 . 9	0 . 2 . 4 5 6 7 8 9
—— rotundifolium, *Linn.*	1 2 3 4 5 . 7 8 9	. 1 2 3 4 5 6 7 8 9	. . . . 4 5 6 7 8 9
—— molle, *Linn.*	1 2 . 4 . . 7 8 9	0 . . . . . 6 7 8 9	0 1 2 . 4 . 6 7 8 9
—— lucidum, *Linn.*	1	 9	. . . . 7 . 9
—— divaricatum, *Ehrh.*	. . . .	. . . . 4	. . . . . 5 . . . .
—— Robertianum, *Linn.*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Erodium cicutarium, *L'Hérit.*	1 2 3 4 5 . 7 8 9	. . 2 3 4 5 6 . 8 9	. . 2 . 4 5 6 7 8 9
—— ciconium, *Linn.*	1 . . . . . . 8 .	. . . . 4 . 6 . . 9	. . 2 . 4 . 6 . . .
Impatiens Noli-tangere, *Linn.*	1 2 . . . . . 8 9	0 . . . . 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Oxalis Acetosella, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— corniculata, *Linn.*	1 2 3 4 5	. . 2 . 4 5 6 . 8 9	0 1 2 3 4 . 6 7 8 9
Tribulus terrestris, *Linn.*	1 . . . . . . 8 .	. . . . 4	. . 2 . . . 6 . 8 .
Ruta graveolens, *Linn.*	1 2 . . . . . 8 .	. . . .	. . 2 . . . 6 . 8 .
Dictamnus Fraxinella, *Pers.*	1 2 3 . . . . 8 9	. . 2 . 4	. . 2 . . . 6 7 8 .
Staphylea pinnata, *Linn.*	. . . .	. . . .	. . 2 . . . 6 7 . .
Euonymus europæus, *Linn.*	1 2 . 4 . . 7 8 9	0 . . . . . 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— verrucosus, *Scop.*	. . . .	. . . .	. . . .
—— latifolius, *Scop.*	1 2	. . . .	0 . . . 4 . . 7 8 9
Zizyphus vulgaris, *Lam.*	1	. . . .	. . . .
Paliurus aculeatus, *Lam.*	1	. . . . 4	. . 2 . . . .
Rhamnus cathartica, *Linn.*	1 2 3 4 . . 7 8 9	. 1 . . 4 . 6 . . 9	. . 2 . 4 5 6 7 8 9
—— saxatilis, *Linn.*	1 . 3 4	. . . .	. . 2 . . . 6 7 8 9
—— alpina, *Linn.*	1 2 . 4 5 6 . 8 .	. . 2 . . . ? . ? .	. ? . . . .
—— pumila, *Linn.*	1 2 . 4 . 6 7 8 9	0 1 2 3 4 5 6 . 8 .	0 1 2 . 4 5 6 7 8 9
—— rupestris, *Scop.*	. . . .	. . . .	. . . . ? . .
—— infectoria, *Linn.*	. . . .	. . . .	. . . .
—— Frangula, *Linn.*	1 2 3 4 5 . 7 8 9	. . 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 .
Pistacia Terebinthus, *Linn.*	. . . .	. . . .	. . . . 8 9
Rhus Cotinus, *Linn.*	1 2 . 4 . . . 8 .	. . . . . . 6 . . .	. . 2 . . . 6 7 8 9
Ulex europæus, *Linn.*	. . . .	. . . .	. . 2 . 4 . . . . .
Spartium junceum, *Linn.*	. 2	. . . .	. . . . 4 . . 7 . 9
Sarothamnus vulgaris, *Wimm.*	1 2 3 4 . . 7 . .	0 . . . 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 .
Genista diffusa, *Willd.*	. . . .	. . . .	. . . .
—— cinerea, *DC.*	1 2	. . . .	. . . .
—— pilosa, *Linn.*	1 2	. . . . 4 9	. . . . 4 . . 7 . .
—— sericea, *Linn.*	. . . .	. . . .	. . . .
—— tinctoria, *Linn.*	1 2 3 4 . 6 . 8 9	0 . . . 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9
—— ——, var. (G. tenuifolia, *Lois.*)?	. . . .	 9	0 1 2 . . . . . , .
—— Delarbrei, *Lec. & Lam.*?	. 2 . . . . . 8 .	. . . .	. . 2 . . . . . . ?
—— ovata, *Waldst. & Kit.*	. . . .	?	. . . .
—— ——, var. (G. mantica, *Poll.*)	. . . .	. . . .	. . . .
—— germanica, *Linn.*	1 2 3 4 5 . 7 8 9	0 . 2 . 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9
Cytisus Laburnum, *Linn.*	. . . . ?	0 . 2 . . . 6 . . .	. . 2 . 4 . 6 7 8 9
—— alpinus, *Mill.*	1 2 3 4 5 6 7 8 9	0 1 . . 4 5 6 7 8 9	. . 2 . 4 ? . 7 8 9
—— nigricans, *Linn.*	. . . . 5 6 7 8 9	0 . . . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— glabrescens, *Sartor.*	. . . .	. . . .	. . 2 . . . 6 7 8 .
—— sessilifolius, *Linn.*	1 2 3 4 . . . 8 .	. . . .	. . 2 . 4 . 6 7 8 9
—— capitatus, *Jacq.*	. . . 4 . 6 . 8 9	0	. . 2 . 4 . 6 7 8 9
—— prostratus, *Scop.*?	. . . .	. . . .	. . . . ? .
—— hirsutus, *Linn.*	1 2 3 4 . 6 . 8 ?	. . . . . 5 6 7 8 9	. . 2 . 4 . 6 . . .
—— purpureus, *Scop.*	. . . .	. . . .	. . 2 . . . 6 . 8 9
—— radiatus, *Mert. & Koch*	. . . .	. . . .	. . . . . . 6 7 . .
—— sagittalis, *Mert. & Koch*	1 2	. . . .	. . . . . . 6 . . .

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . . 7 8 .	. . . .	.	. A G I . . . P S K	Geranium palustre.
0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— sanguineum.
. . . 3 4 5	. . . 3 . 5 6 7 . .	50	F . ? I . C	—— argenteum.
0 1 2 3 . . 6 7 8 .	. . . .	.	F A G I L C N P . K	—— pyrenaicum.
. . . 3 4 5 . . 8 .	0 1 . 3 4 5	.	F A G I L C N P S K	—— pusillum.
. . . . . 5 . . . 9	. . . .	.	F A G . . . N . S K	—— bohemicum.
. . . . 4 5 6 . 8 .	0 1 . 3 4 5 . 7 . .	.	F A G I L C N P S K	—— dissectum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— columbinum.
0 1 2 3 4 5 . 7 8 .	0 1 2 3 4 . . 7 8 .	50	F A G I L C N P S K	—— rotundifolium.
0 1 2 3 4 5 6 . . .	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— molle.
. . . . . 5 . . 8 .	0	50	F A G I L C N P S K	—— lucidum.
. . . . 4 5 . 7 8 .	. . . .	.	. A . . . . . P . K	—— divaricatum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Robertianum.
0 1 2 . 4 5 6 . 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	Erodium cicutarium.
. . . .	0	.	F . . I L C N P . K	—— ciconium.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . .	.	F A G I L C N P S K	Impatiens Noli-tangere.
0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 7 . 9	50	F A G I L C N P S K	Oxalis Acetosella.
. 1 2 . 4 5 6 7 8 .	0 1 . 3 4	50	F A ? I L C N P . K	—— corniculata.
. . . .	0	50	. . . I L C N ? . ?	Tribulus terrestris.
. 1 2 3 4 5 . 7 8 .	0 1 . 3 . . . 7 . .	50	F . . I L C N P . K	Ruta graveolens.
0 1 2 . 4 5 . . 8 .	0 1 . 3 . . . 7 8 .	50	F A G I L C ? . . K	Dictamnus Fraxinella.
. . . . 4 5	0 . . 3 . . . . 8 .	50	. . G I . C N . . K	Staphylea pinnata.
0 . 2 . 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Euonymus europæus.
. . . 3 . . . . 8 .	. . . . 8 .	50	. . G I . . . . . K	—— verrucosus.
. . 2 3 4 5 . 7 . .	0 1 . 3 . . . 7 8 .	50	F A G I L C N . . K	—— latifolius.
. . . .	. . . .	50	. . . ? . . N . . .	Zizyphus vulgaris.
. 1 2 . 4 5	0 1	50	. . . I L C N . . .	Paliurus aculeatus.
0 1 2 3 4 5 . 7 8 .	0 1 2 3 . 5 . 7 8 .	50	F A G I L C N P S K	Rhamnus cathartica.
0 1 2 3 4 5 6 . . .	0 1 . 3 4 5 . 7 . .	50	F A G I . C . . . K	—— saxatilis.
. . . .	. . . .	50	F A G I L C N P . K	—— alpina.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I ? C N P . .	—— pumila.
. . . .	. . . . 7 . .	50	. . . I . . . . . K	—— rupestris.
. . . .	. . . . 7 . .	.	. . . I L . . P . .	—— infectoria.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— Frangula.
. 1 2 . 4 5	0 1	50	F . . I L C N P . .	Pistacia Terebinthus.
0 1 2 3 4 5 6 . 8 .	0 1 2 3 4 5 . 7 8 .	50	F A . I L C N . . K	Rhus Cotinus.
. . . .	. . . .	.	. A . . L C N P . .	Ulex europæus.
. 1 2 . 4	0 . . 3 . . . . 8 .	50	? . G I L C N . . .	Spartium junceum.
0 . . . . ?	. . . .	.	F A G I L C N P S K	Sarothamnus vulgaris.
0	0 1 . 3 . . . 7 . .	50	. A G I L C N ? . K	Genista diffusa.
. . . .	. . . .	.	F . . I L . . P . .	—— cinerea.
. . . .	. . . . 8 .	50	F A G I L C N P S K	—— pilosa.
. . . . 4	. 1 . 3 . . . 7 . .	50	. . . I	—— sericea.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— tinctoria.
. . . .	0 1 . 3	.	. . . . ? C N . . .	—— ——, var. (G. tenuifolia)?
. . . . 4	. . . 3	.	. ? . . . . . P . .	—— Delarbrei.
0 . . . 4 5	0	50	. A G I L C N . . K	—— ovata.
. . . . ? ? .	0 . . 3	.	. . . .	—— ——, var. (G. mantica).
0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 . 7 8 9	50	F A G I L C ? P S K	—— germanica.
0 1 . . 4 5	0 1 . 3 . . . 7 8 .	50	. A . I L C N . . K	Cytisus Laburnum.
0 1 2 3 4 5 6 . 8 .	0 1 2 3 . . . 7 8 .	.	F A G I L C . . . K	—— alpinus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C . . . K	—— nigricans.
. . . .	. . . .	.	. . . I	—— glabrescens.
0 1 2 3 4 5 6 . . .	0 1 . 3 . . 5 . . .	.	F A . I L C N P . .	—— sessilifolius.
. . . . 4 5	0 1 . 3 9	.	. . . I L C . . . K	—— capitatus.
0	. . . 3 . . . 7 8 9	50	F . G I L C N P . K	—— prostratus.
. 1 . 3 4 5 . 7 8 .	0 . . . 3 4 . 7 . .	.	F . . I L C N P . K	—— hirsutus.
0 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 . 7 . 9	50	. . G I	—— purpureus.
0 1 2 3 4 5 6 . . 9	0 1 2 3 4 5 6 7 . 9	.	F A G I L C N . . K	—— radiatus.
. . ?	. . . . 7 8 .	50	F A G I L C N P . K	—— sagittalis.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Cytisus argenteus, *Linn.*	1	. . . .	. . . . 7 8 9
Ononis spinosa, *Linn.*	1 2 . . . . . 8 9	. . . . . . 6 . . 9	0 . 2 . 4 5 6 7 8 9
—— ——, var. (O. repens, *Linn.*)	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . . . . .
—— hircina, *Jacq.*?	. 2	. . . . 4 9	. . 2 . 4 . 6 . . .
—— Columnæ, *All.*	1 2 3 4 . . 7 8 .	. 1 2 . 4 5	. . 2 . . . . 7 8 9
—— striata, *Gouan*	1 2	. . . .	. . . .
—— minutissima, *Linn.*	1 2 3 4 . . 7 8 .	. . . . . . 6 . . 9	. . 2 9
—— Natrix, *Lam.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 . 8 9	. . 2 . 4 5 6 7 8 .
—— rotundifolia, *Linn.*	1 . 3 . . . 7 8 .	. . 2 . . . . . 8 .	. . . . . 5 . . . .
—— cenisea, *Linn.*	1 2 3 4 5 6 7 8 .	. . . . . . 6 . . 9	. . . .
—— reclinata, *Linn.*	. . . . 8 .	. . . .	. . . .
Anthyllis Vulneraria, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (A. vulnerarioides, *Bonj.*).	. . . . 8 .	. . ?	. . . .
—— montana, *Linn.*	1 2 3 4 . . 7 . .	. . . . 8 9	. . 2 . 4 5 . 7 . .
Medicago falcata, *Linn.*	1 2 . 4 . . 7 8 9	0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (M. procumbens, *Bess.*)	1 . . 4	 9	. . . . . 5 . 7 8 .
—— ——, var. (M. glomerata, *Balb.*)	1 2	. . . .	. . . . 7 . .
—— orbicularis, *All.*	1 2 . . . . . 8 .	. . . .	. . . . 7 8 9
—— ——, var. (M. marginata, *Willd.*)	. . . .	. . . .	. . . . 8 .
—— lupulina, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Pironæ, *Vis.*	. . . .	. . . .	. . . .
—— lappacea, *Lam.*	. . . .	. . . .	 9
—— maculata, *Linn.*	1 2	. . . . . . 6 . . .	. . . .
—— Gerardi, *Waldst. & Kit.*	1	. . . .	. . . . 7 8 9
—— minima, *Lam.*	1 2 . 4 . . . 8 .	. . . . . . 6 . . 9	. . 2 . 4 . 6 7 8 9
—— ——, var. brachycodon, *Rchb.*	. . . .	. . . .	. . . . 8 .
—— laciniata, *All.*	. 2	. . . .	. . . .
—— carstiensis, *Jacq.*	. . . .	. . . .	. . . . . . 6 7 8 9
Trigonella monspeliaca, *Linn.*	. 2 . . . . . 8 .	. . . .	. . . . 4 . . . 8 9
Melilotus dentata, *Pers.*	. . . .	. . . . 4	. . . .
—— macrorhiza, *Pers.*	. . . . 8 .	. . . .	. . . . 7 8 .
—— alba, *Desr.*	1 2 3 . . . 7 . .	. . 2 3 4 5 6 . . .	0 1 2 3 4 5 . 7 8 .
—— officinalis, *Desr.*	1 2 . 4 5 6 7 8 .	. . 2 3 4 5 6 . . .	. 1 2 . . 5 6 7 8 .
—— cærulea, *Lam.*	. . . .	. . . .	. . . .
Trifolium pratense, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (T. nivale, *Sieb.*)	. . 3 4 5 . . 8 9	. 1 2 . . 5 6 7 8 .	0 1 . 3 4 5 . 7 8 .
—— medium, *Linn.*	. 2 . . 5 . 7 8 9	0 . . . . . 6 . 8 9	. 1 2 . 4 5 . 7 8 .
—— alpestre, *Linn.*	1 2 3 4 . . 7 8 9	0 . 2 . 4 5 6 7 . 9	. . 2 . 4 . 6 7 8 9
—— rubens, *Linn.*	1 2 . . . . . 8 9	. . . . . . 6 . 8 .	. 1 2 . 4 . . . . .
—— pannonicum, *Jacq.*	. 2 ? 4 5 6 . . .	. . . .	. . . .
—— noricum, *Wulf.*	. . . .	. . . .	. . . .
—— ochroleucum, *Linn.*	1 2 . . . . 7 8 .	. . . . . . 6 . 8 9	. . 2 . 4 . 6 7 8 9
—— stellatum, *Linn.*	. . . .	. . . .	. . . .
—— incarnatum, *Linn.* (spont.?)	1 2 9	. . . . . . 6 . . 9	. . 2 . . . . . 8 9
—— angustifolium, *Linn.*	1 2 . . . . . 8 .	. . . .	. . . . 8 .
—— arvense, *Linn.*	1 2 3 4 . 6 7 8 9	0 . 2 . . 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9
—— striatum, *Linn.*	. 2 . . 5 . . . 9	. . . .	. . . . 8 .
—— scabrum, *Linn.*	1 2 . . . . . 8 .	. . . . . . 6 . . .	. . 2 . . . . 7 8 9
—— saxatile, *All.*	. . 3 . 5	0 . 2 . . . . . 8 .	. . . .
—— fragiferum, *Linn.*	1 2 3 4 . . . 8 .	. 1 2 3 4 5 6 7 . .	. . 2 4 . . . 7 8 .
—— alpinum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Balbisianum, *Ser.*	. 2	. . . .	. . . .
—— montanum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— hybridum, *Linn.*	. . . . 8 .	0 1	0 . . . . 5 . . . .
—— repens, *Linn.*	1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— pallescens, *Schreb.*	. . . . 8 9	0 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 . . 8 .
—— cæspitosum, *Reyn.*	1 2 3 4 5 6 . 8 9	. 1 . 3 . 5 6 7 8 .	. 1 . . 4 5 6 7 8 .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. 1 2 . 4	0	.	F . . I L C N . . .	Cytisus argenteus.
. . 2 3 4 5 . 7 8 9	0 1 2 3 4 5 . 7 . 9	50	F A G I L C N P S K	Ononis spinosa.
. . 2 3 4 5 6 7 8 9	. 1 . 3 4 5	.	F A G I . C . P S .	—— ——, var. (O. repens).
. . . . 7 8 9	. . . .	.	. A G I L . . . S K	—— hircina.
0 . 2 . 4 5 . . 8 .	0	.	F . . I L C N P . K	—— Columnæ.
. . . .	. . . .	.	F . . . . . . P . .	—— striata.
. 1 . . 4	0 1	.	F . . I L C . P . .	—— minutissima.
. 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 . 7 . .	.	F A . I L C N P . .	—— Natrix.
. . . . 4 5 . 7 8 9	. . . . 4	.	F A G . . . . P . .	—— rotundifolia.
. . . .	. . . .	.	F . . . . . N P . .	—— cenisea.
. . . . 4	. . . 3	.	. . . I L C N P . .	—— reclinata.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	Anthyllis Vulneraria.
. . . .	. . . .	.	F . . . . . . P . .	—— ——, var. (A. vulnerarioides.).
. . . . 4 5	. . . . 7 . .	50	F A G I L C N P . .	—— montana.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Medicago falcata.
. . . . 4 . . 7 . .	. . . 3 . . . 7 . .	50	? . G . . . . ? . .	—— ——, var. (M. procumbens).
. . . .	. . . .	.	? . . . L . . ? . .	—— ——, var. (M. glomerata).
. 1 . . 4 5	0 1	.	. . . I L C N . . .	—— orbicularis.
. . . .	. . . .	.	. . . I	—— ——, var. (M. marginata).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— lupulina.
. . . .	. . . . 7 8 .	50	. . . .	—— Pironæ.
. . . .	. . . .	.	. . . ? . . ? ? . .	—— lappacea.
. . . .	. . . 3 . . . 7 . .	.	F . . I L C N P . .	—— maculata.
. . . . 4 5	0 1 . 3	.	. . . I L C N P . K	—— Gerardi.
0 1 2 . 4 5 . 7 8 .	0 1 2 3 4 . . 7 8 .	50	F A G I L C N P S K	—— minima.
. . . .	. . . 3	.	. . . . . . N . . .	—— ——, var. brachycodon.
. . . .	. . . .	.	. . . I	—— laciniata.
. . . .	0 1 . 3	50	. . G I	—— carstiensis.
. . . . 4 . . 7 . .	0	.	? A G I L C N . . .	Trigonella monspeliaca.
. . . .	. . . .	.	. . . I . . . . S K	Melilotus dentata.
. . . .	. . . 3	50?	F A G I ? C N P S K	—— macrorhiza.
. 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 .	.	F A G I L C N P S K	—— alba.
. . 2 3 4 5 . 7 8 .	0 1 . 3 4	50	F A G I L C N P S K	—— officinalis.
. . . . 4 . . 7 8 .	0 . . . 4	.	. . . I . . . . . K	—— cærulea.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Trifolium pratense.
. . . 3 . . 6 7 8 .	. 1 2 3 4 . 6 7 . .	.	F A G . . . . P . ?	—— ——, var. (T. nivale).
. 1 . 3 4 5 6 . 8 .	0 1 . 3 . 5 . 7 . .	.	F A G I L C N P S K	—— medium.
0 . . . 4 5 . . 8 .	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— alpestre.
. 1 2 3 4 5 . 7 8 .	0 1 . 3 . . . 7 8 .	50	F A G I L C . P . K	—— rubens.
. . . .	. . . .	.	. . . I L . . . . K	—— pannonicum.
. . . .	. . . . 7 . .	.	. . G I	—— noricum.
. . 2 . 4 5 . 7 8 .	0 . . 3 . . . . 8 .	.	F A G I L C N P S K	—— ochroleucum.
. . . .	. . . 3	50	. . . I L C N P . .	—— stellatum.
. . . . . 5	0 1 . 3	.	F ? . I L C N P . .	—— incarnatum.
. 1 . . 4	0	50	. . . I L C N P . .	—— angustifolium.
. 1 2 3 4 5 . 7 8 .	0 1 . . 3 4	.	F A G I L C N P S K	—— arvense.
. . . . . 5 . 7 8 .	0 . . 3	50	F A G I L C N P S K	—— striatum.
. 1 2 . 4 5 . 7 . .	0 . . 3	50	F A ? I L C N P . K	—— scabrum.
. . . .	. . . .	.	F A	—— saxatile.
. . 2 . 4 5 6 7 8 .	0 . . 3 4 5 . 7 . .	.	F A G I L C N P S K	—— fragiferum.
0 . . 3 4 5 6 7 8 9	. 1 . 3	.	F A G I L C . P . K	—— alpinum.
. . . .	. . . .	.	?	—— Balbisianum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— montanum.
. . . . . 5 . 7 8 .	0 . . . . 5 . . 8 .	.	. A G I . ? N . S .	—— hybridum.
0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 . . . 9	50	F A G I L C N P S K	—— repens.
. . 2 3 4 . 6 7 8 9	. . . 3 4 5 6 7 . .	.	F . G I	—— pallescens.
. . . 3 4 5 . 7 8 .	. . 2 3 4 . . 7 . 9	.	F A G I L C N P . K	—— cæspitosum.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Trifolium nigrescens, *Viv.*	1	. . . . 4	. . . . 8 .
—— spadiceum, *Linn.*	1	. . . . . . 6 . . .	. . . . 8 .
—— badium, *Schreb.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 8 .
—— agrarium, *Linn.*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 . 8 9
—— procumbens, *Linn.*	1 2 . . . 6 . 8 .	. . . . . . 6 . . 9	. . 2 . . . . 7 8 .
—— patens, *Schreb.*	1 2 . 4 . 6 . . .	0 1 . . . 5 6 . . 9	? . 2 3 4 . . 7 8 9
—— filiforme, *Linn.*	. . . . 8 .	. . . .	. . . . 4 . . 7 8 .
—— micranthum, *Viv.*	. . . .	. . . .	. . . . 7 8 .
Dorycnium herbaceum, *Vill.*	. . . . . . 7 8 9	. . . . . . 6 . . 9	. . 2 . . . 6 7 8 9
—— suffruticosum, *Vill.*	1 2	. . . .	. . . .
Bonjeania hirsuta, *Reichb.*	1 2	. . . . . . 6 . . .	. . 2 . 4 . . . . .
Lotus corniculatus, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— uliginosus, *Schk.*	. . . 4 5 . . 8 .	0 . 2	. . . .
Tetragonolobus siliquosus, *Roth.*	1 2 3 4 5 6 7 8 9	. 1 2 3 4 . 6 . . 9	. . 2 . 4 5 . 7 8 9
Psoralea bituminosa, *Linn.*	1 2	. . . .	. . . .
Galega officinalis, *Linn.*	. . . . 8 9	. . . . . 6	. . 2 . 4 . 6 . . .
Colutea arborescens, *Linn.*	1 . . . . . . 8 9	. . 2 3 4 . 6 . . 9	. . 2 . . . 6 . 8 .
Phaca frigida, *Linn.*	. . . . 5	. . . . . 5	. . . 3 . . . 7 8 .
—— alpina, *Jacq.*	1 2 3 . 5 6 7 8 9	. . 2 . . 5 6 . 8 .	0 1 . 3 4 5 . 7 8 9
—— australis, *Linn.*	1 2 . . 5 6 . 8 .	. . 2 . 4 5 6 7 8 .	. . . . . 5 . 7 . .
—— astragalina, *DC.*	1 . 3 . 5 6 7 8 9	. 1 2 3 4 5 6 . 8 .	0 . 2 . 4 5 6 . . .
Oxytropis Halleri, *Bunge*	. . . . 5 6 7 8 .	. 1 2 3 4 5 6 7 . .	. . . . . 5 . . 8 .
—— campestris, *DC.*	. 2 . 4 5 6 7 8 9	. 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 . 7 . .
—— fœtida, *DC.*	. . . . 5 6 7 8 .	. . 2 . . 5 ? 7 . .	. . . .
—— pilosa, *DC.*	. . . . . . 7 8 .	. . . . . 5	. . . . . . 6 7 . .
—— lapponica, *Gaud.*	. . . . 8 .	. 1 2 . 4 5 . . ? .	. 1 . . . 5 . . . .
—— montana, *DC.*	1 2 . . . . . 8 .	. . . . . 5 6 7 8 .	. . 2 . 4 5 6 . 8 9
—— Gaudini, *Bunge*	1 2 . . . 6 7 8 .	. 1 2 . . 5 6 . . .	. . . . 8 .
Astragalus leontinus, *Wulf.*	. . . . 5 . . 8 .	. . 2 . . 5	. . . . . ? . . . .
—— purpureus, *Lam.*	1 2	. . . . . 5	. . . . . . 6 7 8 .
—— hypoglottis, *Linn.*	1 . . . . . . 8 .	. . 2	. . . .
—— Onobrychis, *Linn.*	1 . . . 5 6 7 8 .	. 1 2 3 4 . 6 . . 9	. . . . 4 5 . . . 9
—— austriacus, *Linn.*	. . . . . . 7 . .	. . . .	. . . .
—— vesicarius, *Linn.*	1 . . . ?	. . . .	. . . .
—— ——, var. (A. Pastellianus, *Poll.*)	. . . .	. . . .	. . . .
—— Cicer, *Linn.*	. 2 . . 5 . . 8 .	. 1 . . 4 . . . 8 .	. . . . . 5 . . 8 .
—— glycyphyllos, *Linn.*	1 2 3 4 . 6 7 8 9	. 1 2 . 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9
—— depressus, *Linn.*	1 2 . . . 6 7 8 .	. . . .	. . . .
—— aristatus, *L'Hérit.*	1 2 . 4 5 6 7 8 .	0 . 2 . . 5 6 . 8 .	0 . . . .
—— exscapus, *Linn.*	 9	. . 2 . 4 5 . . 8 .	. . . .
—— alopecuroides, *Linn.*	. . . .	. . 2 . . ?	. . . .
—— monspessulanus, *Linn.*	1 2 3 4 5 6 7 8 .	. 1 2 3 4 5 . . 8 .	. . 2 . . . 6 . . .
—— Wulfenii, *Koch*	. . . .	. . . .	. . . .
Coronilla Emerus, *Linn.*	1 2 . 4 . . 7 8 9	0 . 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— vaginalis, *Linn.*	. . . .	. . . .	. . 2 . 4 5 6 7 8 9
—— var. (C. minima, *Linn.*)	1 2 3 4 . . . 8 .	 9	. . . . . 5 6 7 8 9
—— montana, *Scop.*	. . . . 8 .	. . . .	. . . . . 5 ? . . .
—— scorpioides, *Koch*	1 2	. . . .	 9
—— var. (C. repanda, *Koch*)	. . . .	. . . .	. . . .
—— varia, *Linn.*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Hippocrepis comosa, *Linn.*	1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9
—— unisiliquosa, *Linn.*	1 . 3	. . . .	. . . .
Hedysarum obscurum, *Linn.*	1 . 3 4 5 6 . . .	. 1 . . . . 6 . . .	. . . . . 5 . 7 8 9
Onobrychis sativa, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 . 7 8 .
—— arenaria, *DC.*	. . . .	. . . .	. . . . . . 6 7 . .
—— Caput-galli, *Lam.*?	?	. . . .	. . . .
Vicia pisiformis, *Linn.*	. . . . 8 9	. . . .	. . . . 8 .
—— sylvatica, *Linn.*	. . . . . 6 7 . .	. . . . . . 6 . 8 9	. . . . 4 5 6 . 8 9
—— cassubica, *Linn.*	. 2	. . . . . . 6 . . .	. . . .
—— dumetorum, *Linn.*	. 2 9	. . . . . . 6 . . .	. . . . 7 8 9
—— Cracca, *Linn.*?	1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9	. . 2 3 4 5 6 7 8 .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . . 9	0	.	. . . I L C N . . .	Trifolium nigrescens.
. . . .	. . . . 7 . .	.	F A G ? ? C N P S K	—— spadiceum.
. . 2 3 . 5 6 7 8 9	. . 2 3 4 5	.	F A G I ? C N P . K	—— badium.
0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— agrarium.
. . . . 4 5 . 7 8 .	0 . . 3	50	F A G I L C N P S K	—— procumbens.
. . . . . 5 . 7 . .	0 . . 3	50	. A G I L C N P . .	—— patens.
. . . . . . 6 7 . .	. . . 3 4	.	F A G I L C N P S K	—— filiforme.
. . . .	. . . .	.	. . . I L C N . S .	—— micranthum.
0 1 2 3 4 5 6 . 8 .	0 1 . 3 4 5 6 7 . 9	50	F . . I L C N . . K	Dorycnium herbaceum.
. 1 . . 4	. . 2	50	F A G I L . . P . ?	—— suffruticosum.
. . . . 4 5 6 7 . .	. . . .	.	. . . I L C N P . .	Bonjeania hirsuta.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Lotus corniculatus.
. . . .	. . . .	50	F A G I L C ? P S K	—— uliginosus.
. . . 3 4 5 6 7 8 9	0 . . 3 . . . 7 . .	50	F A G I L C N P S K	Tetragonolobus siliquosus.
. . . .	. . . .	.	. . . I L C N P . .	Psoralea bituminosa.
. . 2 . 4 5 . 7 . .	0 1 . 3 . . . 7 . .	50	. A . I L C N P . K	Galega officinalis.
0 . 2 3 4 5 6 7 8 9	0 . . 3 . 5 . ? . .	50	F A . I L C N P . K	Colutea arborescens.
. . . . 7 8 .	. . . 3 4	.	F A G . . . . . S K	Phaca frigida.
. . . 3 4 . . 7 8 9	. . . 3 4	.	F A G I . . . P S K	—— alpina.
. . 2 . . . . 7 8 .	. . . . 4 . . 7 . .	.	F A G . . C N P . K	—— australis.
. 1 2 3 . 5 . 7 8 9	. . . 3 4 5 . . . 9	.	F A G . . . . P S K	—— astragalina.
. . . 3 . . . 7 8 9	. . . .	.	F A G . . . . P S K	Oxytropis Halleri.
. . . . 7 8 9	. . . 3 4 5 . . . 9	.	F A G I ? C N P S K	—— campestris.
. . . .	. . . .	.	F A	—— fœtida.
. . . . . 5 . 7 . .	. . . .	.	F A G ? . . N P S K	—— pilosa.
. . . . 7 . .	. . . .	.	. A . . . . . . S .	—— lapponica.
0 . 2 3 4 5 . 7 8 9	. . 2 3 4 5 6 7 . 9	50	F A G I . . N P . K	—— montana.
. . . . 8 .	. . . .	.	F A . . . . N . . .	—— Gaudini.
. . . .	. . . 3	.	F A G . L	Astragalus leontinus.
. . . . 8 9	. . . . 4	.	F . . I L C N P . .	—— purpureus.
. . . .	. . . .	.	F A G . . . . . S .	—— hypoglottis.
. . . . 4 5 6 7 8 .	0 1 2 3 4 . . 7 . 9	50	F A G I . . ? . . K	—— Onobrychis.
. . . .	. . . .	.	F . . I . . . . . K	—— austriacus.
. . . . 7 . 9	. . . ?	50	F A G I . . N . . K	—— vesicarius.
. . . .	0	.	. . . I	—— ——, var. (A. Pastellianus.)
. . . 3 4 5 6 7 8 9	0 . . 3 4 5	.	F A G I L C . . . K	—— Cicer.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— glycyphyllos.
. . . . 4 9	. . . 3 4	.	F A . I . C N P . .	—— depressus.
. . . .	. . . .	.	F A . . L C N P . .	—— aristatus.
. . . . 7 . .	. . . .	.	. A . . . . K	—— exscapus.
. . . .	. . . .	.	F	—— alopecuroides.
. 1 2 3 . . 6 . . .	0	.	F A . I L C N P . .	—— monspessulanus.
. . . .	. . . .	50	. . . I . . . . . K	—— Wulfenii.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	Coronilla Emerus.
. . . . 8 9	0 . . 3 . . . 7 . .	.	F A G I . . N . . K	—— vaginalis.
0 1 2 . 4 5 . . . 9	0 1 . . 4 5 . 7 . .	.	F A . . L C N P . .	—— var. (C. minima).
. . 2 . 4 5	. 1 . 3 . . . 7 . .	50	F A G I . . . . . K	—— montana.
. . . . 4	0	.	. . . I L C N . . .	—— scorpioides.
. . . .	0	.	. . . . . . N . . .	—— var. (C. repanda)
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P . K	—— varia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	Hippocrepis comosa.
. . . .	. . . .	.	. . ? I L C N P . ?	—— unisiliquosa.
. . 2 . . 5 6 7 8 9	. . . . 4 5 . 7 . 9	.	F A G I . . . . S K	Hedysarum obscurum.
0 . 2 . 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	.	F A G I L C N P . K	Onobrychis sativa.
. . . .	0 1 . . . . . 7 . .	50	. A . I	—— arenaria.
. . . .	. . . . 7 . .	.	. . . I L C N P . K	—— Caput-galli.
. . . . . 5 . . 8 .	. ?	.	. A G . . . . . S K	Vicia pisiformis.
. . 2 . . 5 6 . 8 .	. . . . 4 5 6 . . .	.	F A G I . C . . S K	—— sylvatica.
. . . .	. . . . . 5	50	? A G I L C N ? S K	—— cassubica.
. . . . 7 . .	. . . 3	.	F A G I L C N P S K	—— dumetorum.
0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 .	.	F A G I ? ? . P S K	—— Cracca.

	0 1 2 3 4 5 6 7 8 9	1 0 1 2 3 4 5 6 7 8 9	2 0 1 2 3 4 5 6 7 8 9
Vicia Gerardi, *DC.*	1 2 3 . . . . 8 9	0 . . . . . 6 . 8 9	0 1 2 . 4 . 6 . . 9
—— tenuifolia, *Roth*	1 2	. . . .	. . . . 7 8 .
—— villosa, *Roth*?	. . . .	. . . .	. . . .
—— pseudocracca, *Bert.*?	. . . .	. . . .	. . . . 8 .
—— dasycarpa, *Ten.*	. . . .	. . . .	. . . .
—— onobrychoides, *Linn.*	. 2 3 . 5 6 7 8 9	. 1	. . . .
—— narbonensis, *Linn.*	1 . ? . . . 7 . .	. . . .	. . . . ? . . . . .
—— bithynica, *Linn.*	. . 3	. . . .	. . . . 8 .
—— sepium, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	. . 2 3 4 5 6 7 8 9
—— pannonica, *Jacq.*	. . . .	. . . .	. . . .
—— ——, var. (V. purpurascens, *DC.*)	. . . .	. . . .	. . . .
—— lutea, *Linn.*	. 2 . . . 6 7 . .	. . . . . . 6 . . 9	. . 2 . 4 . 6 . . 9
—— hybrida, *Linn.*	. . . .	 9	. . . .
—— grandiflora, *Scop.*	. . . .	. . . .	. . . .
—— sativa, *Linn.*	1 2 . . . . 7 8 9	. . . . . . 6 . . 9	0 . 2 . 4 . . 7 8 .
—— angustifolia, *Roth*	1 2 . . . . . 8 .	. . . .	. . 2 . 4 5 . . 8 9
—— —— var (V. cordata, *Wulf.*)?	. . . .	. . . .	. . . .
—— ——, var. (V. Bobartii, *Forst.*)	. . . .	. . . .	. . . . 8 .
—— lathyroides, *Linn.*	1 . . . . 6 . . .	. . . .	. . . . 4 . 6 7 8 .
—— peregrina, *Linn.*	. . . .	. . . .	. . . .
Ervum hirsutum, *Linn.*	1 2 . . . . . 8 .	. . . . . . 6 . . 9	. . 2 . 4 5 6 7 8 9
—— tetraspermum, *Linn.*	. . . .	. . . .	. . . .
—— gracile, *DC.*	? . . . . . . ? .	. . . .	. . . . ? . . . 8 .
Lathyrus Aphaca, *Linn.*	1 2 . 4 . . 7 8 9	. 1 . 3 4 . 6 . . 9	. . 2 . 4 5 6 7 8 9
—— Nissolia, *Linn.*	 9	. . . .	. . 2 . 4 . . . 8 .
—— inconspicuus, *Linn.*	. . . .	. . . .	. . . . 8 .
—— sphæricus, *Retz.*	1 2 . . . 6 . 8 9	. . . . . . 6 . . .	. . ? . 4 9
—— Cicera, *Linn.*	?	. . . .	. . . . 8 .
—— sativus, *Linn.*	. . . .	. . . .	. . . .
—— setifolius, *Linn.*	1	. . . .	. . . . . . 6 . 8 9
—— angulatus, *Linn.*	. . . .	. . . .	. . . . 7 8 9
—— hirsutus, *Linn.*	. . . . 8 .	. . . . . . 6 . . .	. . 2 . . . . 7 8 .
—— tuberosus, *Linn.*	. 2 . . . . . . ?	. . . .	. . . .
—— pratensis, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (L. sepium, *Scop.*)	. . . .	. . . .	. . . .
—— sylvestris, *Linn.*	1 2 3 4 . . 7 8 .	. 1 2 3 4 5 6 . 8 9	0 1 2 . 4 5 . 7 8 9
—— heterophyllus, *Linn.*	1	. . . .	. . . .
—— palustris, *Linn.*	. . . .	. . . . 4	. . . .
Orobus vernus, *Linn.*	1 2 3 4 . . . 8 9	. . . . . . 6 7 . 9	0 . 2 . 4 5 6 7 8 9
—— ——, var. (O. gracilis, *Gaud.*)	. . . .	. . . .	0 . 2 . . . 6 7 . .
—— variegatus, *Ten.*	. . . .	. . . .	. . . .
—— tuberosus, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 . 4 . 6 . 8 9	0 . 2 . 4 . 6 7 8 9
—— ——, var. (O. tenuifolius, *Roth*)	. . . .	 9	. . . . . . 6 . 8 .
—— vicioides, *DC.*	. . . .	. . . .	. . . .
—— albus, *Linn. fil.*	. . . .	. . . . . . 6 . . .	. . . .
—— varius, *Soland.*	. . . . 8 .	. . . .	. . . .
—— canescens, *Linn. fil.*	. 2 9	. . . .	. . 2 . . . .
—— luteus, *Linn.*	1 2 3 . . . 7 . 9	. . . . . . 6 . 8 .	. . 2 . . 5 6 . . .
—— niger, *Linn.*	1 2 . . . . . 8 9	. . . . . . 6 . . 9	. 1 2 . . . . 7 8 9
Cercis Siliquastrum, *Linn.*	1 . . . . . . 8 .	. . . .	. . 2 . 4 . . . . .
Prunus spinosa, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— institia, *Linn.* (spont.?)	. . . . . . 7 . .	. . . .	. . . . 8 .
—— avium, *Linn.*	1 . 3 4 . . . 8 9	. 1 2 3 4 5 6 7 8 9	. 1 2 . 4 . 6 7 8 9
—— Chamæcerasus, *Linn.*	. . . .	. . . .	. . . .
—— brigantiaca, *Vill.*	1 2 . . . . 7 8 .	. . . . 4	. . . .
—— Padus, *Linn.*	. . . . 8 9	. . . . . . 6 . . 9	. . 2 . 4 . . . . .
—— Mahaleb, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 . . 7 8 9	. . 2 . 4 . 6 . 8 .
Spiræa ulmifolia, *Scop.*	. . . .	. . . .	. . . .
—— chamædryfolia, *Linn.*	. . . .	. . . .	. . . .

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . . 4 . 6 7 8 .	. 1	.	F A ? I L C N P . .	Vicia Gerardi.
. . . . 7 . .	. . . .	.	F A G I ? . . P S K	—— tenuifolia.
. . . . 4 . 5 . . .	. . . . 7 . .	.	. A ? ? . C N . S K	—— villosa.
. . . .	. . . .	.	. . . I L C N . . .	—— pseudocracca.
. 1 . . 4 5 . 7 . .	0 1 . 3	.	? . . I . C N ? . K	—— dasycarpa.
. . . .	. . . . 7 . .	.	F A . I L C N ? . .	—— onobrychoides.
. . . .	0	.	. . . I L C N ? . K	—— narbonensis.
. . . .	. . . .	50	. . . I L C N P . .	—— bithynica.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P S K	—— sepium.
. . . .	. . . .	50	. . G I . . . . . K	—— pannonica.
. . . .	. . . 3	.	. . . I L C N . . .	—— ——, var. (V. purpurascens).
. . . . 4 5 . . 8 .	0 . . 3	50	F A G I L C N P . K	—— lutea.
. . . .	. . . .	.	. . . I L C N P . .	—— hybrida.
. . . .	. . . . 8 .	50	. . . I . C N . . K	—— grandiflora.
. 1 2 . 4 5	0 1 . 3 . . . 7 . .	50	F A G I L C N P S K	—— sativa.
. . 2 3 4 5 6 7 8 .	0 1 . 3 4 5	.	F A G I L C N P S K	—— angustifolia.
0 . . 3 4	. . . .	.	. . . I . . . . . K	—— ——, var. (V. cordata).
. . . .	0 . 2 3	.	F . . . L C . P S ?	—— ——, var. (V. Bobartii).
. . . . . 5 . . 8 .	0 . . 3 . . . . 8 .	.	F A G I L C N P S K	—— lathyroides.
. . . . 4 5	0 . . 3	.	F . G I L C N P . .	—— peregrina.
0 1 2 . 4 5 . 7 8 .	0 1 2 3 4 5	.	F A G I L C N P S K	Ervum hirsutum.
. . . . 8 .	. . . .	.	F A G I L C N P S K	—— tetraspermum.
. . . .	. . . .	.	F . . I L C N P . .	—— gracile.
0 1 . . 4 5	0 1 2 3 . 5	50	F A G I L C N P . K	Lathyrus Aphaca.
. . . .	0 . . 3 . . . 7 . .	50	F A . I . C N P . K	—— Nissolia.
. . . .	. . . .	.	. . ? I	—— inconspicuus.
. . . . 4 5 . . 8 .	0 1	50	. A . I L C N . . .	—— sphaericus.
. 1	0	.	. A . I L C N . . .	—— Cicera.
. . . . 4	. . . . 7 . .	.	F . . I L C N P . K	—— sativus.
. 1 2 . 4 5	0	.	. . . I L C N P . .	—— setifolius.
. . . .	0 . . 3	50	. A . I L ? N . . .	—— angulatus.
. . . . . 5	. . . 3 . . . 7 . .	50	F . . I L C N P . K	—— hirsutus.
. . . . . 5 . 7 8 .	0 1	.	F A ? I L C ? P S K	—— tuberosus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— pratensis.
. . . .	. . . .	50	. ? . I . . . . . K	—— ——, var. (L. sepium).
0 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 . 7 . .	50	F A G I L C N P S K	—— sylvestris.
. . . . 7 8 .	. . . . . 5	.	F A G . . . . . S K	—— heterophyllus.
. . . . . 5	. . . 3	.	. A G ? . . . . S K	—— palustris.
0 1 . 3 4 5 . 7 8 .	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	Orobus vernus.
. 1	. 1 2 . . . . 7 8 .	.	. A G I	—— ——, var. (O. gracilis).
. . . . 4 . . 7 8 .	. . . 3	.	. . . I L C N . . .	—— variegatus.
0 1 2 3 4 . 6 7 . .	. 1 2 3 4 5 . . 8 .	50	F A G I L C N P S K	—— tuberosus.
. . . . 4	0	.	F A G I L C . ? S ?	—— ——, var. (O. tenuifolius).
. . . . 4 5 . 7 . .	. . 2 3	.	. . G I	—— vicioides.
. . . .	. . . .	.	F . ? I . . N P . K	—— albus.
. . . . 4	. . . .	.	. . . I . C	—— varius.
. . . .	. . . .	.	F A . . . . . P . K	—— canescens.
. . . . 4 5 . . 8 .	. 1 2 3 4 5 6 7 8 .	50	F A G I L C . P . K	—— luteus.
. 1 2 . 4 5 . 7 8 .	0 1 2 3 . . . 7 8 .	50	F A G I L C N P S K	—— niger.
. . 2 . 4 5	0 1 . 3	.	. . . I ? C N . . .	Cercis Siliquastrum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	Prunus spinosa.
. . . . . 5 . . 8 .	. . . 3	.	F ? G I . C . P S .	—— insititia.
. 1 2 3 4 5 . . 8 9	0 1 . 3 4 5 . 7 . .	50	F A G I L C N P S K	—— avium.
. . . . 8 .	. . . .	.	. . . . K	—— Chamaecerasus.
. . . .	. . . .	.	F	—— brigantiaca.
. . . 3 . . . 7 8 .	. . . 3	.	F A G . . . . . S K	—— Padus.
. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . .	50	? A G I L C N P . K	—— Mahaleb.
. . . .	. . . . 7 . .	50	. . . I . . . . . K	Spiræa ulmifolia.
. . . .	. . . . 7 8 .	.	. . . I . . . . S K	—— chamædryfolia.

	0 (1 2 3 4 5 6 7 8 9)	1 (0 1 2 3 4 5 6 7 8 9)	2 (0 1 2 3 4 5 6 7 8 9)
Spiræa decumbens, *Koch*	. . . .	. . . .	. . . .
—— Aruncus, *Linn.*	1 2 3 4 5 . 7 8 9	0 . . . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Ulmaria, *Linn.*	1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .
—— ——, var. (S. denudata, *Hayne*).	1 . 3 9	. . . .	. . . . 7 8 .
—— Filipendula, *Linn.*	1 2 . . . . . 8 9	. . . . . . 6 . . 9	. . 2 . 4 5 . 7 8 9
Dryas octopetala, *Linn.*	1 2 . 4 5 . 7 8 9	. 1 2 3 4 5 6 7 8 9	. 1 . . 4 5 6 7 8 9
Geum urbanum, *Linn.*	1 2 . 4 . . 7 8 9	0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— rivale, *Linn.*	1 2 3 4 . 6 7 8 .	. . 2 . 4 5 6 7 8 9	. . 2 . 4 5 6 7 . 9
—— reptans, *Linn.*	1 . . . . . 7 8 .	. 1 2 3 . 5 6 7 8 .	. . . . 4 5 . 7 8 .
—— sylvaticum, *Pourr.*	. 2	. . . .	. . . .
—— montanum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Rubus Idæus, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— cæsius, *Linn.*	1 2 3 . . . . 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— fruticosus, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (R. corylifolius, *Gron.*).	 9	. . . . . . 6 . . .	. . . . 7 8 .
—— ——, var. (R. tomentosus, *Borkh.*).	1 2 3	. . . . 4 . 6 . . .	. . . . 8 .
—— ——, var. (R. glandulosus, *Bell.*).	. 2 3 4 . . 7 . 9	. . . . . . 6 7 . 9	. 1 2 . . . 6 7 8 9
—— saxatilis, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
Fragaria vesca, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— elatior, *Ehrh.*	. ?	. . . .	. . . . 7 8 .
—— collina, *Ehrh.*	. . . .	. . . .	. . . . 7 8 9
Comarum palustre, *Linn.*	. . . . 8 9	. . . . 8 9	. . 2 . . . .
Potentilla supina, *Linn.*	. . . .	. . . .	. . . .
—— norvegica, *Linn.*	. . . .	. . . . . 5 . 7 . .	. . . .
—— rupestris, *Linn.*	1 2 3 4 . . 7 8 9	0 1 . . . . 6 7 . 9	. . 2 . 4 . . . 8 .
—— multifida, *Linn.*	. . . . 8 .	. . . . . . ? . 8 .	. . . .
—— Anserina, *Linn.*	. . . .	. . 2 3 4 . 6 . 8 9	. . 2 . 4 5 6 . 8 .
—— recta, *Linn.*	. 2 3 . . 6 . 8 9	. . . . . . 6 . . 9	. . 2 . 4 . 6 . 8 9
—— ——, var. (P. laciniosa, *Lehm.*)	. . . .	. . . .	. . . . 4 . . . . .
—— hirta, *Linn.*	1 . . . . . . 8 .	. . . .	. . . . 8 .
—— inclinata, *Vill.*	. 2 . . . . . 8 .	. . . .	. . . 3 . . 6 . . .
—— argentea, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (P. collina, *Wibel* ?).	. 2	. . . .	. . . . 8 .
—— intermedia, *Linn.*	. . 3 . 5 . . 8 9	. . . .	. . 2 . . . . 7 . .
—— reptans, *Linn.*	1 2 3 4 . . . 8 9	. 1 2 3 4 5 6 7 8 .	0 1 2 3 . . 6 7 8 9
—— Tormentilla, *Sibth.*	1 2 3 4 . 6 7 8 9	0 1 . 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— camonia, *Rota*	. . . .	. . . .	. . . . 8 .
—— aurea, *Linn.*	. . . . 5 . . . 9	0 1 . 3 . 5 6 7 8 .	0 1 2 3 4 5 6 7 8 9
—— alpestris, *Hall. fil.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 8 9
—— ——, var. (P. ambigua, *Gaud.*)	. . . . 5	. . . .	. . . .
—— verna, *Linn.*	1 2 3 4 . . 7 8 9	. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 . . 9
—— ——, var. (P. pusilla, *Host.*)	. . . .	. . . .	. . . .
—— ——, var. (P. opaca, *All., an L.?*)	. . . . . 6 . 8 .	. 1 . . . 5 6 . . 9	. . . . 4 5 . 7 8 9
—— cinerea, *Chaix*	1	. . . .	. . . .
—— grandiflora, *Linn.*	1 2 3 4	. 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . . 8 .
—— ——, var. (P. pedemontana, *Reut.*).	. . . . 5 6 7 8 9	0 . 2	. . . .
—— nivea, *Linn.*	. . . . . . 7 . .	. . . . 7 . .	. . . . . 5 . . . .
—— minima, *Hall. fil.*	. 2 . . . . . 8 .	0 . . . . . 6 . . .	. . . . . 5 . 7 . .
—— frigida, *Vill.*	. . . . . 6 . 8 .	. . 2 3 4 5 6 . . .	. . . . 4 5 . 7 . .
—— alba, *Linn.*	1 2 . . . . . 8 9	. . . . 4 5 6 . . 9	. . 2 . 4 . 6 7 8 9
—— Fragariastrum, *Ehrh.*	1 2 3 . . . . 8 .	. . 2 . 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 .
—— grammopetala, *Moretti*	. . . .	. . 2 . . . 6 7 8 9	. . . .
—— caulescens, *Linn.*	1 2 3 4 . 6 . 8 9	. 1 . . 4 . 6 . . .	. 1 2 . 4 5 6 7 8 9
—— ——, var. (P. petiolulata, *Gaud.*)	. 2	. . . .	. . . . . . 6 . . .

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . .	. . . 3 4 5 6 7 . .	.	. . . I	Spiræa decumbens.
0 1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 . 7 8 .	.	F A G I L C . P . K	—— Aruncus.
. . 2 3 . 5 6 . 8 9	0 1 2 3 . 5 . 7 8 .	.	F A G I L C ? P S K	—— Ulmaria.
. . . . . 5 6 . 8 9	. . . 3 . 5	.	. · G . L C N . S K	—— ——, var. (S. denudata).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— Filipendula.
. 1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P S K	Dryas octopetala.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 . 5 . 7 8 9	50	F A G I L C N P S K	Geum urbanum.
0 . . 3 4 5 6 7 8 .	0 1 2 3 4 . . 7 8 9	.	F A G I L C ? P S K	—— rivale.
. . . . . . 6 7 8 9	. . . 3 4 5	.	F A G I . . . . . K	—— reptans.
. . . .	. . . .	.	. . . . P . .	—— sylvaticum.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	.	F A G I L C ? P . K	—— montanum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . . 7 8 .	50	F A G I L C N P S K	Rubus Idæus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . . 7 8 9	50	F A G I L C N P S K	—— cæsius.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— fruticosus.
. . . . 4 . . . 8 .	0 . . 3 4	.	F A . . L C . P S ?	—— ——, var. (R. corylifolius).
. 1 . . 4 . . . 8 .	0	.	F . G I L C N P ? K	—— ——, var. (R. tomentosus).
. 1 . 3 4 9	0 1 . 3 4 5	.	F A G I L C N . S K	—— ——. var. (R. glandulosus).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	50	F A G I L ? N P S K	—— saxatilis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Fragaria vesca.
. . . . . 5 . 7 8 9	. . . 3 . . . 7 . .	50	. A G I . . . . S K	—— elatior.
. . . . 4 5 . 7 8 .	0 1 . 3	.	F A G I ? C ? P S K	—— collina.
. . . . 8 9	. . . 3 4 . . 7 . .	.	. A G ? . . . P S K	Comarum palustre.
. . . . 4 5 . 7 8 .	. . . .	.	. A G ? . . N . . K	Potentilla supina.
. . . .	. . . . 4	.	. . G . . . . . S K	—— norvegica.
. . 2 3 4 5 6 7 8 9	. . . 3 4 5 . 7 . .	.	F A G ? L C ? P S K	—— rupestris.
. . . .	. . . .	.	F A . I . . . . S .	—— multifida.
. . 2 . 4 5 . . 8 9	0 1 2 3 4 5	.	F A G I ? C ? P S K	—— Anserina.
. . 2 . 4 5 6 7 8 .	0 1 . 3 . . . . 8 .	.	F A G I L C N . . K	—— recta.
. . . .	. . . .	.	. . . .	—— ——, var. (P. laciniosa).
. . . .	. . . 3	.	F . G I L C N P . K	—— hirta.
. . . . . 5	. . . .	?	F A G I L C N . . K	—— inclinata.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 . . .	.	F A G I L C N P S K	—— argentea.
- . . . . . . 7 8 .	. . . .	.	. . G . . . . . S K	—— ——, var. (P. collina).
. . . . ?	. . . .	.	F A . . . . . ? S K	—— intermedia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— reptans.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Tormentilla.
. . . .	. . . .	.	. . . .	—— camonia.
0 . 2 3 4 5 6 7 8 9	. 1 2 3 4 5	.	F A G ? L C . P . K	—— aurea.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	.	F A G I L C N P S K	—— alpestris.
. . . .	. . . .	.	. A	—— ——, var. (P. ambigua).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . .	.	F A G I L C N P S K	—— verna.
. . . .	. . . .	50	? . . I	—— ——, var. (P. pusilla).
. . . . 8 .	. . . .	.	F A G I L C N P S K	—— ——, var. (P. opaca).
. . 2 . . . . 7 . .	. . . .	50	F A G I . . . . S K	—— cinerea.
0 . . 3 4 . 6 7 8 9	. . . 3	.	F A G I L . . ? . .	—— grandiflora.
. . . .	. . . .	.	F ? . . L	—— ——, var. (P. pedemontana).
. . . . 7 . .	. . . .	.	F A G . . C . . S .	—— nivea.
. . . . 7 . 9	. · . 3	.	F A G I . . . P . .	—— minima.
. . . . 7 . 9	. . . .	.	F A G	—— frigida.
. 1 . . 4 5 6 7 8 .	0 1 . 3 . . . 7 . .	50	F A G I . . . P . K	—— alba.
0 1 . 3 4	0 1 . 3 . 5	.	F A G I L C N P . K	—— Fragariastrum.
. . . .	. . . .	.	. . . .	—— grammopetala.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P . K	—— caulescens.
. . 2	 9	.	F A . . . C . P . .	—— ——, var. (P. petiolulata).

	0 1 2 3 4 5 6 7 8 9	1 0 1 2 3 4 5 6 7 8 9	2 0 1 2 3 4 5 6 7 8 9
Potentilla Clusiana, *Jacq.*	. . . .	. . . .	. . . .
—— Valderia, *Linn.*	1 2 3	. . . .	. . . .
—— Saxifraga, *Ard.*	1 2	. . . .	. . . .
—— nitida, *Linn.*	. . . .	. . . .	. . . . 4 5 6 7 8 .
Sibbaldia procumbens, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 8 9
Agrimonia Eupatoria, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
Aremonia agrimonioides, *Neck.*	. . . .	. . . .	 9
Rosa pimpinellifolia, *Linn.*	1 2 . . 5 . 7 8 .	. 1 2 . . 5 6 . 8 .	. . . . 7 . 9
—— alpina, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 . 4 5 6 7 8 9	0 . 2 . 4 5 6 7 8 9
—— rubrifolia, *Vill.*	. . . .	0 . . . . . . 6 . . .	. . 2 . 4 . . 7 . 9
—— ——, var. (R. glandulosa, *Bell.*).	1 . . . . ? . 8 .	. . . .	. . . . . . ? . . .
—— canina, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (R. collina, *Jacq.*)	. . 3	. . . .	. . . . 4 . . 7 8 .
—— rubiginosa, *Linn.*	1 . 3 4 9	. 1 2 . 4 5 6 . . .	. . . . 4 5 6 7 . .
—— ——, var. (R. agrestis, *Savi*).	. . . . 8 .	. . . .	 9
—— tomentosa, *Sm.*	1 . 3 4 5 6 7 . .	0 . 2	. . . . 7 8 .
—— pomifera, *Herrm.*	. . . . 8 .	. 1 2 . 4 5 6 7 8 .	0 1 . . . . . 7 8 9
—— arvensis, *Huds.*	. . . . 8 .	. . . . . . 6 . . 9	. . 2 . 4 . . 7 8 9
—— gallica, *Linn.*	1 . 3 . . 6 . . ?	. . . .	. . . . 7 8 .
—— cinnamonea, *Linn.*	. . . . . . 7 . .	 9	. . 2 . . . .
Alchemilla vulgaris, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (A. pubescens, *Bieb.*).	1 . . . . 6 7 8 9	. . . . . . 6 . . .	. . 2 . 4 5 6 . . .
—— ——, var. (A. fissa, *Schum.*).	. 2 . . . 6 . ? .	. . 2 . 4 5 6 . 8 .	0 1 . 3 4 5 . . 8 9
—— alpina, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— pentaphyllea, *Linn.*	1 . . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . . 4 5 . . 8 .
—— ——, var. (A. cuneata, *Gaud.*).	. . . .	. . . . 4	. . . .
—— arvensis, *Scop.*	. . . . 8 9	. . . . . . 6 . . 9	. . 2 . 4 . 6 7 8 9
Sanguisorba officinalis, *Linn.*	1 2 3 4 . 6 . 8 9	0 . . . 4 . 6 . . 9	0 1 . . 4 5 . . 8 .
—— dodecandra, *Moretti*	. . . .	. . . .	. . . . 4 . . . 8 .
Poterium dictyocarpum, *Spach.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9
—— polygamum, *Waldst. & Kit.*?	. . . .	. . . .	. . . . 8 .
Cratægus Oxyacantha, *Jacq.*	. . . 4	. . . . . . 6 . 8 9	. . . . 4 . . 7 8 9
—— ——, var. (C. monogyna, *Jacq.*)	1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9
—— Azarolus, *Linn.* (spont.?)	. . . .	. . . .	. . . . 8 .
—— Pyracantha, *Linn.* (spont.?).	. . . .	. . . . . . 6 . . 9	. . . . 7 8 .
Cotoneaster vulgaris, *Lindl.*	1 2 . 4 . . 7 8 9	0 1 2 3 4 5 6 . 8 .	0 1 2 . 4 5 . 7 8 9
—— ——, var. (C. tomentosa, *Lindl.*)	. . . .	. . . .	. . 2 . 4 . 6 7 8 .
Mespilus germanica, *Linn.*	. . . . 8 .	. . . . 4 . 6 . . 9	. . 2 . 4 . . 7 8 .
Cydonia vulgaris, *Pers.*	. . . .	. . . .	. . . .
Pyrus communis, *Linn.*	. . . . 8 .	. . . .	. . 2 . . . . 7 8 .
—— Malus, *Linn.*	1 2	. . . . . . 6 . . 9	. . 2 . . . 6 7 8 .
Aronia rotundifolia, *Pers.*	1 2 3 4 5 6 7 8 9	. 1 2 . 4 5 6 7 8 9	0 1 2 . 4 5 6 7 . 9
Sorbus domestica, *Linn.*	1 2	. . . .	. . . . 4 . . . 8 .
—— Aucuparia, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— scandica, *Fr.*?	. . 3 . . . . 8 .	. 1 9	. . . .
—— Aria, *Crantz*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9
—— latifolia, *Pers.*?	. . . .	. . . .	. . . . 8 .
—— torminalis, *Crantz*	1	. . . . . . 6 . . .	. . 2 . . . . . 8 9
—— Chamæmespilus, *Crantz*	1 2 . . . . 7 8 .	. . . . . . 6 . . .	. . . . 4 5 6 7 8 9
Epilobium angustifolium, *Linn.*	1 2 3 . . 6 7 8 9	0 1 2 3 4 5 6 7 . 9	0 1 2 3 4 5 . 7 8 9
—— Dodonæi, *Vill.*	1 2 3 4 5 . 7 8 9	. 1 . . 4 5 6 . 8 9	0 1 2 3 4 . 6 7 8 9
—— Fleischeri, *Hochst.*	1 2 3 . . 6 . 8 9	0 1 2 3 4 5 6 7 8 .	. 1 2 3 4 5 6 . 8 .
—— hirsutum, *Linn.*	1 . 3 . . . . 8 9	0 . . . . . 6 . . .	. . 2 . 4 . 6 7 8 .
—— parviflorum, *Schreb.*	1 2 3 4 . 6 . 8 9	0 1 2 3 4 5 6 . 8 .	0 1 2 . 4 5 6 7 8 9
—— lanceolatum, *Seb. & Mauri*	. . 3 . 5 . . 8 .	. . . .	. . 2 3 . 5 . . . .
—— montanum, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— palustre, *Linn.*	1 2 3 . 5 . . . 9	0 9	0 . . . 4 5 . . . .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . .	. . . 3 . . . 7 . .	.	. . G I . . . . . K	Potentilla Clusiana.
. . . .	. . . .	.	. . . .	—— Valderia.
. . . .	. . . .	.	. . . . L	—— Saxifraga.
. 1 2 3 4 5 6 . 8 9	. 1 2 3 4 5 6 7 . 9	50	F . G I . C	—— nitida.
0 . . 3 . . 6 7 8 9	. . . 3 4 5	50	F A G I . . N P S .	Sibbaldia procumbens.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	.	F A G I L C N P S K	Agrimonia Eupatoria.
. 1 2 3 4 5	. 1 2 3	50	. . . I L . . P . K	Aremonia agrimonioides.
. . . . 4 5 . . 8 .	0 . 2 3	50	F A G I L C N P S K	Rosa pimpinellifolia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— alpina.
. . . . . 5 . 7 8 .	. . . 3 . 5 . 7 . .	.	F A G I . C . P . K	—— rubrifolia.
. . . .	. . . .	.	F A G I . . . P . .	—— ——, var. (R. glandulosa).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P S K	—— canina.
. . . . 4 . . . 8 9	0 . . 3	.	F A G I . C N ? S K	—— ——, var. (R. collina).
. . . . 4 5 6 . 8 .	0 . . 3	.	F A G I L C N P S K	—— rubiginosa.
. . . . 4 . . . 8 9	0 1 . 3	.	. . . . L C N . . .	—— ——, var. (R. agrestis).
. . . . 4 5 6 7 8 9	. . . 3	.	F A G I . . . P S K	—— tomentosa.
. . . 3 . . 6 7 . 9	. . . 3 4 5	50	F A G I L C N P S K	—— pomifera.
. . . 3 4 5	0 1 . 3 4 . . 7 . .	.	F A G ? L C N P . K	—— arvensis.
. . . . . 5 . . 8 .	0 . 2 3 . . . . 8 .	50	. ? . I ? C N . . K	—— gallica.
. . . .	. . . . 7 . .	.	. A G ? . . . . S K	—— cinnamonea.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Alchemilla vulgaris.
0 . 2 . 4 5 6 7 8 .	. . 2 3 . . . 7 . 9	50	F . G I L	—— ——, var. (A. pubescens).
. . . . . . 6 7 8 .	. . . .	.	F A G ? . . . P S .	—— ——, var. (A. fissa).
0 . . 3 4 5 . 7 8 9	0 1 . 3 . . . 7 . .	50	F A G I L C N P S K	—— alpina.
0 . . 3 . . 6 7 . 9	. . . .	.	F A . . L . . ? . .	—— pentaphyllea.
. . . .	. . . .	.	. A	—— ——, var. (A. cuneata).
. 1 2 . 4 5 . . . 9	0 1 2 3 . 5 . 7 . .	50	F A G I L C N P S K	—— arvensis.
. . . . 7 8 .	. . . .	50	F A G I L C N P S K	Sanguisorba officinalis.
. . . .	. . . .	.	. . . .	—— dodecandra.
0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Poterium dictyocarpum.
. . . .	 9	.	F A G I L C N P . K	—— polygamum.
0 1 . 3 4 5 6 7 8 .	0 1 . 3	50	F A G I L C N P S K	Cratægus Oxyacantha.
0 . 2 . 4 . . . 8 9	0 1 2 3 4 . 6 7 8 9	.	F A G I L C N P S K	—— ——, var. (C. monogyna).
. . . .	. . . .	.	. . . I	—— Azarolus.
. . . . 4	. . . .	.	F . . I L C N P . .	—— Pyracantha.
. . . . 4 5 6 7 8 9	0 . 2 3 4 5 . . 8 .	.	F A G I L C N P S K	Cotoneaster vulgaris.
. . . 3 4 5 6 7 . .	. . . 3 . . . 7 . .	.	F A G I . . N P . K	—— ——, var. (C. tomentosa).
. . . . 4 . . 7 8 .	. 1 . 3 . . . . 8 .	50	F A G I L C N P . K	Mespilus germanica.
. . . . . 5 . . 8 .	0 . . 3	.	. A G I L C . . . K	Cydonia vulgaris.
. . . . 4 5 6 . 8 .	0 1 . 3 . . . 7 . 9	.	F A G I L C N P S K	Pyrus communis.
. 1 . 3 4 5 . . 8 .	0 1 . 3 . . . 7 . .	50	F A G I L C N P S K	—— Malus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	Aronia rotundifolia.
. . . . . 5 . 7 . .	0 1 . 3	.	F . . I L C . . . K	Sorbus domestica.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— Aucuparia.
. . . .	. . . .	.	F A . . . . . P S .	—— scandica.
0 1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 . . 8 .	50	F A G I L C N P S K	—— Aria.
. . . .	. . . .	.	. . . . K	—— latifolia.
. 1 . . 4 5 . 7 8 .	0 . . 3	.	F A G I L C N P . K	—— torminalis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 . . 9	.	F A G I L . N P . K	—— Chamæmespilus.
0 . 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 .	50	F A G I L C N P S K	Epilobium angustifolium.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	50	F A G I L C N . . K	—— Dodonæi.
. . . 3 . . 6 7 . .	. . . .	.	F A G	—— Fleischeri.
. . . . 4 5 6 7 . 9	0 1 . 3 . 5 . 7 8 .	.	F A G I L C N P S K	—— hirsutum.
. 1 . 3 4 5 6 7 8 .	0 1 2 3 . 5 . 7 . .	.	F A G I L C N P S K	—— parviflorum.
. . . . . . 6 7 . .	. . . .	.	F . . I L C N ? . .	—— lanceolatum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P S K	—— montanum.
0 . . 3 . 5 6 7 8 9	. . 2 3 4	.	F A G I L C N P S K	—— palustre.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Epilobium tetragonum, *Linn.*	. . . . 5 6 . 8 9	. . . . 4 5 6 . . 9	. . . . 4 5 . . . .
—— roseum, *Schreb.*	1 2	. . . .	. . 2 . 4 . . 7 8 ?
—— trigonum, *Schrank*	. . . .	. . . .	. . . . 4 . 6 7 . .
—— origanifolium, *Lam.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 9
—— alpinum, *Linn.*	1 2 . . 5 . . 8 9	0 1 2 3 . 5 6 7 8 .	0 1 . 3 4 5 . . 8 .
Œnothera biennis, *Linn.*	. . . 4 . . . 8 .	. . . .	0 . 2 . 4 . 6 7 8 .
Isnardia palustris, *Linn.*	. . . .	. . . . . . 6 . . 9	0 . 2 . . . .
Circæa lutetiana, *Linn.*	1 2 3 4 . 6 . 8 9	0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 .
—— intermedia, *Ehrh.* (?)	. . . . . 6 . . .	. . . .	 9
—— alpina, *Linn.*	1 2 . . 5 6 . 8 .	0 . 2 . . . 6 7 . 9	. . 2 3 4 . 6 . 8 9
Trapa natans, *Linn.*	. . . .	 9	0 . 2 3 . . 6 . . .
Myriophyllum spicatum, *Linn.*	. . . . 8 .	. . . . . . 6 . . 9	0 . 2 . 4 . 6 . 8 .
—— verticillatum, *Linn.*	. . . .	 9	0 . 2 . . . 6 . 8 .
Hippuris vulgaris, *Linn.*	. . . . 8 .	. . . . . . 6 . . 9	0 . 2 . . . 6 . 8 .
Callitriche stagnalis, *Scop.*	. . . .	. . . . . . 6 . 8 .	. . 2 . . . 6 . . .
—— vernalis, *Kuetz.*	. . . . 8 9	. . . . . . 6 . . .	0 1 2 3 . . . 7 . .
Ceratophyllum demersum, *Linn.*	. . . . 8 .	. . . . . . 6 . . 9	. . 2 . . . 6 7 8 .
—— submersum, *Linn.*	. . . .	. . . . . . 6 . . 9	. . 2 . . . . 7 8 .
Lythrum Salicaria, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .
—— hyssopifolium, *Linn.*	1 2 . . . . . 8 .	. . . . . . 6 . . 9	. . ? . ? . . . . .
Peplis Portula, *Linn.*	. . . . 8 9	. . . . . . 6 . . 9	0 . 2 3 4 . 6 . . .
Myricaria germanica, *Desv.*	1 2 3 . . . 7 8 .	0 1 2 . 4	0 1 . 3 4 5 6 7 8 .
Philadelphus coronarius, *Linn.*	. . . .	. . . .	. . 2 . . . .
Myrtus communis, *Linn.*	. . . .	. . . .	. . 2 . . . 6 . . .
Bryonia dioica, *Jacq.*	1 2 3 4 . . . 8 .	. . . . 4 . 6 . . 9	. . 2 . 4 . 6 7 8 .
—— alba, *Linn.*	. . . . 8 .	. . . . . . 6 . . 9	. . . .
Portulaca oleracea, *Linn.*	1 2 . . . . . 8 .	. . . . 4 . 6 . 8 9	0 . 2 3 4 5 6 7 8 .
Montia fontana, *Linn.*	. . . . 8 .	. . . . 4 . 6 . 8 9	. . . . 4 . . . 8 9
Telephium Imperati, *Linn.*	1 2 . . . . . 8 .	. . . .	. . . .
Herniaria glabra, *Linn.*	1 2 3 4 5 . 7 8 .	. 1 2 3 4 5 6 . . 9	0 . 2 . . . 6 7 8 .
—— hirsuta, *Linn.*	1 2 . . . . 7 8 .	. . . . . . 6 . . .	. . 2 . . . . 7 8 9
—— incana, *Lam.*	1 . . 4 . . 7 8 .	. . . .	. . . .
—— alpina, *Vill.*	1 . . . 5 6 . 8 .	. 1 2 . 4 5 . . 8 ?	. . . .
Paronychia capitata, *Lam.*	. . . . . 6 7 8 9	. . . . 4	. . . .
—— ——, var. (P. serpyllifolia, *DC.*)	1 2 . . . . 7 8 9	. . . .	. . . .
—— polygonifolia, *DC.*	1 2 3 4 5 . 7 8 .	. . 2 . . 5	. . . .
Ortegia dichotoma, *Linn.*	. . . . 8 .	. . . .	. . . .
Polycarpon tetraphyllum, *Linn.*	1 2 . 4 5 6 . 8 .	. . . . 4 9	. . . . 4 . . 7 8 9
Scleranthus annuus, *Linn.*	. . 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 . 2 3 4 5 6 7 8 9
—— perennis, *Linn.*	1 2 3 4 . 6 . 8 9	0 1 2 . 4 5 6 7 8 9	0 1 2 . 4 . 6 . 8 .
Rhodiola rosea, *Linn.*	1 2 3 . 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Sedum maximum, *Suter*?	1 2 3 4 . . . 8 9	0 . 2 . 4 5 6 7 8 9	0 1 2 3 4 . . 7 . 9
—— Anacampseros, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 . . .	. . . .
—— alsinefolium, *All.*	1 2 3 4 5 6 . . .	. . . .	. . . .
—— galioides, *All.*	. . . .	. . . .	0 . 2 . 4 . . 7 8 .
—— stellatum, *Linn.*	? . . . . ? . . .	. . . . . . ? ? . .	. . . .
—— hispanicum, *Linn.*	. . . .	. . . .	. . 2 . . . . . 8 .
—— villosum, *Linn.*	. . . . 8 9	0 . 2	. . . 3 . 5 . . 8 .
—— rubens, *Linn.*	. . . . . 6 . 8 9	. . . . . . 6 . . .	. . 2 9
—— atratum, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 .	. . . 3 4 5 6 7 8 .
—— annuum, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 . . .
—— album, *Linn.*	1 2 5 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— hirsutum, *All.*	. . . . . 6 . . .	. . . .	. . . .
—— dasyphyllum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— acre, *Linn.*	1 . 3 4 5 6 7 8 9	0 1 2 . . . 6 7 . .	0 . 2 . 4 5 6 7 8 9
—— sexangulare, *Linn.*	1 2 . 4 . . . 8 9	. . . . 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— alpestre, *Vill.*	1 2 3 . 5 . . 8 9	. 1 2 3 4 5 6 7 8 .	0 1 . . 4 5 . . . .
—— altissimum, *Poir.*	1 2	. . . . . . ? . . .	. . . .
—— reflexum, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (S. glaucum, *Sm.*)	. 2 3 4 5 . . ? ?	. . . . 4 . . . 8 9	0 . . . .

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. 1 . . . . 6 . . .	? ? . . . 5 . . . 9	.	F A G I L C N P S K	Epilobium tetragonum.
. 1 . . . 5 . 7 8 9	. . . 3 4 . . 7 . .	.	F A G ? L C ? P S K	—— roseum.
. . . 3 4 . 6 7 8 9	. . . 3 4	.	F A G	—— trigonum.
0 . 2 3 4 5 6 7 8 9	. . 2 . 4 5	.	F A G I L C N P S K	—— origanifolium.
0 . 2 3 . . 6 7 8 9	. . . 3 4 . . 7 . .	.	F A G I . C . P S K	—— alpinum.
. . 2 . . 5 . . 8 .	0 . . 3	.	F A G ? . C . P . K	Œnothera biennis.
. . . . 4	. . . . 7 . .	50	? A G I . C . ? . .	Isnardia palustris.
. . 2 3 4 5 6 7 8 .	0 1 . 3 4 5 . 7 8 .	50	F A G I L C N P S K	Circæa lutetiana.
. . . .	. . 2 3 4	.	F A G . . C . . S K	—— intermedia.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I ? C N P S K	—— alpina.
. . . .	. . . . 7 . .	.	F A G I . C . . . K	Trapa natans.
. . . . . 5 . . 8 .	0 . . 3 . . . 7 . .	.	F A G I L C N P S K	Myriophyllum spicatum.
. . 2 . 4 5 . 7 . .	0 . . . . . . 7 . .	.	F A G I L C N ? S K	—— verticillatum.
. . . . . 5 . 7 8 .	. . . .	.	F A G I ? C N P S K	Hippuris vulgaris.
. . 2 . . 5 . 7 . .	. 1 . 3 4 . . 7 . .	.	F A G I . . . P S K	Callitriche stagnalis.
. . 2 . 4 5 . 7 8 .	. . . 3	50	F A G I L C N P S K	—— vernalis.
. . 2 . 4 5 . 7 8 9	0 . . 3 . . . 7 . .	.	F A G I L C N P S K	Ceratophyllum demersum.
. . . . 4 5 . . 8 .	0	.	. . . . S ?	—— submersum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P S K	Lythrum Salicaria.
. . . . 4	. . . . 8 .	50	F A G I L C N ? . K	—— Hyssopifolia.
. . . . 4 5 . 7 8 .	. . . .	.	F A G I ? C N P S K	Peplis Portula.
. . . . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P S K	Myricaria germanica.
. . 2 . 4 5 . 7 . 9	0 1 . 3 4	50	. . G I . C . . . K	Philadelphus coronarius.
. . . .	. . . .	.	. . . I L C N . . .	Myrtus communis.
. . 2 3 4 5 6 7 . .	0 1 . 3 . . . . 8 .	.	F A G I L C N P . K	Bryonia dioica.
. . . . 8 .	. . . .	50	. A G I . . . . S K	—— alba.
. . . 3 4 5 6 7 8 9	0 1 . 3 . 5	.	F A G I L C N P S K	Portulaca oleracea.
. . . . 4 . 6 7 8 9	0 . 2 3	50	F A G I L C N P S K	Montia fontana.
. . . . . 5 . 7 . .	. . . .	.	F A . . . . . P . .	Telephium Imperati.
. . . 3 4 5 . . 8 9	0 1 . 3 4	.	F A G I L C N P S K	Herniaria glabra.
. . . . 4	0 . . 3	.	F A G I L C N P . K	—— hirsuta.
. . . .	. . . .	.	F ? . I . . ? P . ?	—— incana.
. . . . 8 .	. . . .	.	F A . . . . . P . .	—— alpina.
. . . .	. . . .	.	F . . I L C N P . ?	Paronychia capitata.
. . . .	. . . . . . 6 . . .	.	F . . . . . . P . .	—— ——, var. (P. serpyllifolia).
. . . .	. . . .	.	F . . I . . . P . .	—— polygonifolia.
. . . .	. . . .	.	. . . .	Ortegia dichotoma.
. 1 . . . 5	0 . . 3 4	.	? . . I L C N P . K	Polycarpon tetraphyllum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	50	F A G I L C N P S K	Scleranthus annuus.
. . 2 3 . 5 6 . 8 .	. . . 3 . 5	.	F A G I L C N P S K	—— perennis.
0 . 2 3 4 5 6 7 8 9	. . . 3 4 5 . 7 8 9	50	F A G I L . . P S K	Rhodiola rosea.
0 1 2 3 4 5 6 7 8 9	0 . . 3	.	F A G I L C N P S K	Sedum maximum.
. . 2 . . 5	. . . .	.	F A . . L C . P . .	—— Anacampseros.
. . . .	. . . .	.	. . . . L	—— alsinefolium.
0	. . . .	.	. ? . . L C N P . K	—— galioides.
. . . .	. . . . . . 6 . . .	.	. A . . L C N . . .	—— stellatum.
0 . 2 . 4	0 1 . 3 4 . 6 7 8 9	50	. A G I . C N . . K	—— hispanicum.
. . . . 8 9	. . . .	.	F A G . . . . P S K	—— villosum.
. . . . 4 5	0 1	.	F A . . L C N P . .	—— rubens.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P . K	—— atratum.
0 . . 3 . 5 6 7 8 9	. 1 2 3 4 5	.	F A G I L C N P S K	—— annuum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— album.
. . . .	. . . .	.	. . . I L . . P . .	—— hirsutum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— dasyphyllum.
0 1 . 3 4 . 6 7 8 9	. 1 2 3 . . 6 7 8 .	.	F A G I L C N P S K	—— acre.
0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 .	50	F A G I L C N P S K	—— sexangulare.
0 . . 3 4 . 6 7 8 9	. . . .	.	F A G I . C ? P . K	—— alpestre.
. . 2	. . . .	.	F . . I L C N P . .	—— altissimum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	.	F A G I L C N P S K	—— reflexum.
. . . . . 5 6 . . 9	. 1 2 3	.	. A . . L C N . . .	—— ——, var. (S. glaucum).

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Sedum anopetalum, *DC.*	1 2	. . . . 7 . .	. . . . 4 . . . 8 .
Sempervivum tectorum, *Linn.*	1 2 3 4 5 . . 8 .	. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 .
—— ——, var. (S. acuminatum, *Schott*)?.	. . . .	. . . . . . 6 . . .	. . . .
—— Wulfenii, *Hoppe*	. . . . 8 9	0 . 2 . 4 5 6 7 . .	. . . . . 5 . . . .
—— montanum, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 2 . 4 5 6 7 . .
—— ——, var. ochroleucum, *Linn.*	. . . .	. . 2 . . 5 6 . . .	. . . .
—— Funkii, *Braun*	. . . .	. . . .	. . . .
—— ——, var. dolomiticum, *Facch.*	. . . .	. . . .	. . . .
—— exile, *Ball*	. . . .	. . . .	. . . .
—— arachnoideum, *Koch*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— hirtum, *Linn.*	1 2 3 4	. . . .	. . . . 8 .
—— arenarium, *Koch*	. . . .	. . . .	. . . .
Umbilicus pendulinus, *DC.*	1 2	. . . . . . 6 . . 9	. . 2 . . . .
Ribes Grossularia, *Linn.*	1 2 3 4 5 6 7 8 .	. 1 2 3 4 5 6 7 8 9	0 1 . 3 . . . . 8 .
—— purpureum, *Rost.*	. . . . . 6 . . .	. . . .	. . . .
—— alpinum, *Linn.*	1 2 3 . . . . 8 9	. . . . . 5 6 7 8 9	. . . . 4 . . . 8 9
—— nigrum, *Linn.*, spont?	1 . . . . 6 . 8 9	. . . . . . 6 . 8 .	. . . .
—— rubrum, *Linn.*	. . . . . . 7 8 .	. . . . . . 6 . . 9	. . . .
—— petræum, *Wulf.*	1 2 . . . . 7 8 .	. . 2 . 4	. . . . 4 . . . 8 .
Saxifraga Cotyledon, *Linn.*	. . 3 . . 6 . 8 9	0 1 . . 4 5 6 7 8 9	0 1 2 3 4 . 6 7 . .
—— elatior, *Mert. & Koch*	. . . .	. . . .	. . . . . 5 6 . 8 9
—— Aizoon, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— crustata, *Vest*	. . . .	. . . .	. . . . . ? 6 7 . .
—— lingulata, *Bell.*	1 2 . 4	. . . .	. . . .
—— ——, var. (S. lantoscana, *Boiss. & Reut.*).	1 2	. . . .	. . . .
—— cochlearis, *Reichb.*	. 2	. . . .	. . . .
—— florulenta, *Moretti*	1 . 3	. . . .	. . . .
—— mutata, *Linn.*	. . . . . ? . . .	. . . .	. . 2 . 4 . 6 7 8 9
—— Burseriana, *Linn.*	. . . .	. . . .	. . . .
—— Vandellii, *Sternb.*	. . . .	. . . .	. . . . . 5 6 7 . .
—— diapensioides, *Bell.*	1 2 3 4 5 6 7 8 .	. . 2 3 . 5	. . . .
—— ——, var. (S. tombeanensis, *Boiss.*)	. . . .	. . . .	. . . .
—— cæsia, *Linn.*	1 2 . 4 5 6 7 8 .	. . . . . . 6 . 8 .	. . . 3 4 5 6 7 8 9
—— ——, var. (S. squarrosa, *Sieb.*)	. . . .	. . . .	. . . . 7 8 .
—— patens, *Gaud.*	. . . .	. . . . . 5 . . 8 .	. . . .
—— valdensis, *DC.*	. . . . 5 6 . 8 .	. . . . . ?	. . . .
—— retusa, *Gouan.*	1 . 3 . 5 6 . 8 9	0 . 2 . 4 5 6 7 8 .	0 . . . .
—— oppositifolia, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (S. Rudolphiana, *Hornsch.*).	. . . . . 6 . ? .	. . . .	. . . . 7 8 .
—— biflora, *All.*	. . . 4 5 . . 8 .	. 1 2 . . 5 6 . 8 .	0 . . . . 8 .
—— aspera, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 9
—— bryoides, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9
—— tenella, *Wulf.*	. . . .	. . . .	. . . .
—— aizoides, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Hirculus, *Linn.*	. . . . . 6 . . .	. . . .	. . . .
—— stellaris, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— cuneifolia, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— umbrosa, *Linn.*	. . . .	. . . .	. . . . 7 . .
—— pedemontana, *All.*	1 2 3 . . . . 8 9	0 . . . . ?	. . . .
—— muscoides, *Wulf.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 .
—— ——, var. (S. acaulis, *Gaud.*)	. . . .	. 1 . . . 5	. . . . 7 8 .
—— ——, var. (S. moschata, *Wulf.*)	1 2 3 . 5 . . 8 .	. 1 . 3 . 5 6 . 8 .	. 1 2 . 4 5 6 7 8 .
—— ——, var. (S. atropurpurea, *Sternb.*).	. . . .	. . . .	. . . . 7 . .
—— exarata, *Vill.*	1 2 3 4 5 . . 8 9	. 1 2 3 . . 6 . 8 .	. . . . 4 5 . 7 8 .
—— stenopetala, *Gaud.*	. . . .	. . . . . . 6 . 8 .	. . . 3 . 5 . . 8 .

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . .	. . . .	.	F A . I L . . P . .	Sedum anopetalum.
0 1 2 . 4 5 . 7 8 .	0 1 9	.	F A G I L C ? P S K	Sempervivum tectorum.
. . . . 4 . . . 8 .	. . . .	.	. . . .	—— ——, var. (S. acuminatum).
. . . 3 . . 6 7 8 9	. . . 3 4	.	. . G ? . . . . . K	—— Wulfenii.
. . . 3 4 . . 7 8 9	. . . 3 . . . 7 . .	.	F A G I L C N P . K	—— montanum.
. . . .	. . . .	.	. . . .	—— ——, var. ochroleucum.
. . . . . . 6 . 8 .	. . . .	.	. . . .	—— Funkii.
. . . . 8 9	. . . .	.	. . . .	—— ——, var. dolomiticum.
. . . . 8 .	. . . .	.	. . . .	—— exile.
0 . . 3 4 5 6 7 8 9	0 . . 3 4 . . 7 8 .	.	F A G I L C N P . K	—— arachnoideum.
. . . . 4 5 . ? 8 .	0	.	F . G I . . . . . K	—— hirtum.
. . . . 8 9	. . . . . 5	.	. . G	—— arenarium.
. . 2	. . . .	.	. . . I L C N P . .	Umbilicus pendulinus.
0 . . . 4 . . 7 8 .	0 . . . . . . 7 . .	.	F A G I L C N P S K	Ribes Grossularia.
. . . .	. . . .	.	. . . .	—— purpureum.
. . . . . 5 . . 8 9	. 1 . 3 4 5	.	F A G I L C N P S K	—— alpinum.
. . . . . ? . . 8 .	. . . .	.	. A G ? . . . . S K	—— nigrum.
. . 2 . 4 . . 7 8 .	0 . . 3	.	. A G I . C N . S .	—— rubrum.
. . . . 4 . ? 7 8 .	. . . 3 . . . 7 . .	.	F A G I . C . P . K	—— petræum.
. . . .	. . . .	.	. A G . . . . P S K	Saxifraga Cotyledon.
0 1 2 . . . . 7 . .	0 1 2 3 4 5 6 7 8 9	50	. . G I . . . . . K	—— elatior.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	50	F A G I L C N P S K	—— Aizoon.
. . . . ? 8 9	. . . 3 4 5 6 7 8 9	50	. . G I . . . . . K	—— crustata.
. . . .	. . . .	.	F . . . L C N . . .	—— lingulata.
. . . .	. . . .	.	. . . .	—— ——, var. (S. lantoscana).
. . . .	. . . .	.	. . . . L	—— cochlearis.
. . . .	. . . .	.	. . . .	—— florulenta.
. 1 2 . 4 5 . 7 8 .	0 1 2 3 4 . . 7 . .	50	F A G . . C . . . K	—— mutata.
. . . . 4 5 . . 8 9	0 . 2 3 4 5 . 7 . .	.	. . G I . . . . . K	—— Burseriana.
. . . . 4 ?	. . . .	.	. . G	—— Vandellii.
. . . .	. . . .	.	F A	—— diapensioides.
. 1 2	. . . .	.	. . . .	—— ——, var. (S. tombeanensis).
0 1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P . K	—— cæsia.
. . . . 7 8 9	. . 2 3 4 5 6 7 . 9	50	. . G I . . . . . K	—— ——, var. (S. squarrosa).
. . . .	. . . .	.	. A G	—— patens.
. . . . ?	. . . .	.	F	—— valdensis.
. . . .	. . . .	.	F A G . . . . P . K	—— retusa.
0 . 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 . 9	.	F A G I L C N P S K	—— oppositifolia.
. . . .	. . . .	.	. . G . . . . . . K	—— ——, var. (S. Rudolphiana).
. . . . 8 .	. . . .	.	F A G I . . . . S K	—— biflora.
0 . 2 3 . 5 6 7 8 9	. . 2 3 4 5 . 7 . .	.	F A G . L C . P . K	—— aspera.
0 . 2 3 4 . 6 7 8 9	. . . 3 4 5 . 7 . .	.	F A G I ? . . P . K	—— bryoides.
. . . .	. . . . 7 8 9	50	. . G I	—— tenella.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	50	F A G I L C N P S K	—— aizoides.
. . . .	. . . .	.	F A G . . . . . S K	—— Hirculus.
0 . 2 3 . 5 6 7 8 9	. . 2 3 4 5 . 7 . .	50	F A G I L C ? P S K	—— stellaris.
0 1 2 3 9	. 1 2 3 . 5 6 7 8 9	.	F A G I L C . P . K	—— cuneifolia.
. . . .	. . . .	.	. . G . . . . P . .	—— umbrosa.
. . . .	. . . .	.	. . . . L . . . . K	—— pedemontana.
. 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . . . 9	.	F A G I L C N P . K	—— muscoides.
. . . . 9	. . . .	.	F A G . . . . ? . .	—— ——, var. (S. acaulis).
0 . . 3 . . . . 8 .	. . . . . 5 . 7 . .	.	F A G I L C N P . K	—— ——, var. (S. moschata).
. . . . 8 9	. . . . . 5	50	. . G	—— ——, var. (S. atropurpurea).
. . . 3 . 5 6 7 8 9	. . . .	.	F A G I L . . P . .	—— exarata.
. . . . . . 6 7 . .	. . . .	.	. A G	—— stenopetala.

	0									1										2									
	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
Saxifraga sedoides, *Linn.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	4	.	6	.	8	.
—— ——, var. (S. Hohenwartii, *Sternb.*).	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
—— Facchinii, *Koch*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
—— planifolia, *Lapeyr.*	.	.	3	.	5	6	.	8	9	.	1	2	.	4	5	6	7	.	.	0	.	.	.	4	.	.	.	8	.
—— Seguieri, *Spreng.*	.	.	.	.	.	.	.	.	.	.	.	2	.	.	5	6	7	8	.	0	1	.	3	4	5	6	7	8	.
—— androsacea, *Linn.*	1	.	3	.	5	6	7	8	9	0	1	2	3	4	5	6	7	8	.	.	.	.	3	4	5	6	7	8	9
—— ——. var. triloba, *Sternb.*	.	.	.	.	.	.	.	.	9	0	.	.	.	.	.	6	.	.	.	.	.	.	.	.	.	.	.	.	.
—— controversa, *Sternb.*	.	.	.	4	5	6	7	8	9	.	.	.	3	4	.	6	.	.	.	.	.	.	.	.	5	.	7	.	.
—— tridactylites, *Linn.*	1	2	.	4	.	.	.	8	.	.	.	.	.	4	5	.	7	.	.	0	.	2	.	.	.	6	7	8	9
—— petræa, *Linn.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	6	7	.	.
—— granulata, *Linn.*	1	2	.	.	.	.	.	8	.	.	.	.	.	4	5	6	.	.	.	.	.	.	.	.	.	.	.	.	.
—— bulbifera, *Linn.*	.	.	.	4	.	6	.	8	.	.	.	.	.	.	.	6	.	.	.	.	.	2	.	4	.	.	7	8	.
—— ——, var. insubrica, *Rota*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.
—— cernua, *Linn.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.
—— rotundifolia, *Linn.*	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
—— arachnoidea, *Sternb.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	9
—— paradoxa, *Sternb.*?	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.
Chrysosplenium alternifolium, *Linn.*	.	2	.	4	5	6	.	8	.	.	.	2	.	4	5	6	7	.	.	.	.	2	.	4	5	6	7	8	9
—— oppositifolium, *Linn.*	.	.	.	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	?	.	.	.	.	.
Sanicula europæa, *Linn.*	1	2	3	4	.	.	7	8	9	.	.	.	.	.	5	6	.	8	9	.	.	2	.	4	.	.	7	8	9
Hacquetia Epipactis, *DC.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Astrantia minor, *Linn.*	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
—— carniolica, *Wulf.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
—— major, *Linn.*	1	2	3	4	.	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	.	2	.	4	5	6	7	8	9
Hydrocotyle vulgaris, *Linn.*	.	.	.	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eryngium campestre, *Linn.*	1	2	.	4	5	.	7	8	9	0	.	2	3	4	5	6	.	.	9	.	.	2	.	4	.	6	7	8	.
—— amethystinum, *Linn.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	?	.	.	.	.	.	.	.
—— alpinum, *Linn.*	1	.	3	.	.	.	.	.	.	.	.	.	.	.	.	?	.	.	.	.	.	.	.	.	.	.	.	.	.
Cicuta virosa, *Linn.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	4	.	.	.	.	.
Trinia vulgaris, *DC.*	1	2	3	4	.	.	7	8	9	.	.	.	.	.	.	6	.	.	.	.	.	2	.	.	.	6	7	8	9
Helosciadum nodiflorum, *Koch*	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	4	.	.	7	8	.
Ptychotis heterophylla, *Koch*	1	2	3	4	.	6	7	8	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Falcaria latifolia, *Koch*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
—— Rivini, *Host*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.
Ammi majus, *Linn.*	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sison Amomum, *Linn.*	.	2	.	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7	8	.
Ægopodium Podagraria, *Linn.*	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	.	1	2	3	.	5	6	7	8	9
Carum Carui, *Linn.*	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
—— Bulbocastanum, *Koch*	1	2	3	4	5	.	7	8	9	.	1	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	7	8	.
Pimpinella magna, *Linn.*	1	2	3	4	.	.	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
—— Saxifraga, *Linn.*	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
—— ——, var. (P. nigra, *Willd.*)?	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	6	7	8	9
—— alpina, *Host*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7	8	9
Berula angustifolia, *Koch*	1	?	.	.	.	.	.	8	9	.	.	.	.	.	.	6	.	.	9	.	.	2	.	4	.	6	7	8	.
Bupleurum tenuissimum, *Linn.*	?	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
—— semicompositum, *Linn.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
—— Gerardi, *Jacq.*	1	2	.	.	5	.	.	.	.	.	.	.	.	.	.	6	.	.	.	.	.	.	.	.	.	.	.	.	.
—— junceum, *Linn.*	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7	.	.
—— aristatum, *Bartl.*	1	2	.	4	.	.	.	8	.	.	.	.	.	.	.	6	.	8	.	.	.	.	.	4	.	.	7	8	9
—— falcatum, *Linn.*	1	.	.	4	5	.	7	8	.	.	.	.	.	.	.	?	.	.	.	.	.	.	.	.	.	.	.	.	.
—— neglectum, *Ces.*	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
—— ranunculoides, *Linn.*	1	2	3	4	.	.	7	8	9	0	1	2	3	4	5	6	.	8	9	0	.	2	.	4	.	6	7	8	.
—— gramineum, *Vill.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
—— graminifolium, *Vahl*	1	2	.	4	.	6	.	.	.	.	1	.	.	.	.	6	.	.	.	.	.	2	.	.	.	6	7	8	.
—— stellatum, *Linn.*	.	2	.	.	5	6	.	8	9	0	1	.	.	.	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
—— rotundifolium, *Linn.*	1	2	.	.	.	.	7	.	.	.	.	.	.	.	.	.	.	.	9	.	.	2	.	.	.	6	7	8	.
Œnanthe fistulosa, *Linn.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	4	.	6	.	.	.
—— pimpinelloides, *Linn.*	.	.	.	.	.	.	.	?	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
—— Phellandrium, *Lam.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	.	.	.	.	.	2	.	.	.	.	.	.	.

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. 1 2 3 4 5 . 7 8 9	. 1 . . 4 5 . 7 . 9	50	. . G I . . N ? . K	Saxifraga sedoides.
. . . . 8 .	. . . .	.	. . G I	—— ——, var. (S. Hohenwartii).
. . . . 8 9	. . . 3 4	.	. . . .	—— Facchinii.
. . . . 8 ?	. . ?	.	F A G . . . . P . K	—— planifolia.
. . . 3 4 5 6 7 . .	. . . .	.	F A G	—— Seguieri.
. . 2 3 4 . 6 7 8 9	. . 2 3 4 5 . 7 . 9	.	F A G I L C N P . K	—— androsacea.
. . . . 9	. . . .	.	. . . . K	—— ——, var. triloba.
. . 2 3 4 5 . 7 8 9	. . . . 4 . . 7 . 9	.	F A G I ? C N P ? K	—— controversa.
0 1 2 3 4 5 6 . 8 .	0 1 2 3 . 5 . 7 8 9	50	F A G I L C N P S K	—— tridactylites.
. . . 3 4 5	0 1 2 3 4 . . 7 8 9	50	. . . I . . . . . K	—— petræa.
. . . .	. . . .	.	F A G ? L C N P S K	—— granulata.
0 . . . 4 5	0	.	. A G . L C N . . K	—— bulbifera.
. . . .	. . . .	.	. . . .	—— ——, var. insubrica.
. . . . 9	. . . . 4 5	.	. A G . . . . . S K	—— cernua.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P . K	—— rotundifolia.
0 1	. . . .	.	. . . .	—— arachnoidea.
. . . .	. . . .	.	. . G	—— paradoxa.
0 . . 3 4 5 . 7 8 9	0 1 . 3 4 5 6 7 8 9	.	F A G I ? C N P S K	Chrysosplenium alternifolium.
. . . .	. . . . 7 . .	.	F A . . . . . P S K	—— oppositifolium.
0 . . 3 4 5 6 . . .	0 1 2 3 4 . 6 7 8 9	.	F A G I L C N P S K	Sanicula europæa.
. . . .	. . . . 7 8 .	50	. . G I . . . . . K	Hacquetia Epipactis.
0 . . 3 4 5 6 7 8 9	. . . 3 . 5 . 7 . .	.	F A ? . L . . P . .	Astrantia minor.
. . . ?	. . . .	.	. . G I . . . . . K	—— carniolica.
0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 . 7 8 .	.	F A G I L C N P . K	—— major.
. . 2	0	.	? A G I ? C N P S K	Hydrocotyle vulgaris.
0 1 . . 4 5	0 1 . 3 . . . 7 . .	.	F A G I L C N P . K	Eryngium campestre.
. . 2 . 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 9	50	. . . I . C . . . K	—— amethystinum.
. . . .	. . . . 7 . 9	.	F A . I	—— alpinum.
. . . . . 5 . . 8 9	. . . .	.	. A ? I . . . . S K	Cicuta virosa.
0 1 2 . 4 5 . . 8 9	0 1 . 3 . . . 7 8 .	50	F A ? I L C N P . K	Trinia vulgaris.
. . . . . 5	. . . .	.	F A ? I L C N P . K	Helosciadum nodiflorum.
. . 2 . 4 5	0 1 . ?	.	F A . . L . . P . .	Ptychotis heterophylla.
. . . .	. . . .	50	. . . ?	Falcaria latifolia.
. . . .	. . . . 8 .	50	F . ? I . . . P S K	—— Rivini.
. . . .	0	.	F . . I L C N P . .	Ammi majus.
. . . . 4	. . . 3	.	. A . I L C N . . .	Sison Amomum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Ægopodium Podagraria.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C ? P S K	Carum Carui.
. . . .	. . . .	.	F A . I L C N ? . K	—— Bulbocastanum.
0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9	50	F A G I L C N P S K	Pimpinella magna.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Saxifraga.
. 1 2 . 4 5	0 1	.	F . G . . . . ? S K	—— ——, var. (P. nigra)?
. 1 2 . 4 5	0 1 . 3 4 . . 7 . .	.	. . G I . . . . . K	—— alpina.
. . . . 4 5 6 7 . .	0 . . 3	.	F A G I L C N P S K	Berula angustifolia.
. . . . 4	. 1 . . 4 . 6 7 . .	.	F ? ? I L C N P S K	Bupleurum tenuissimum.
. . . .	. . . .	50	. . . I . C	—— semicompositum.
. . . .	. . . .	.	F . . I L . . . . K	—— Gerardi.
. . . . 4	0	50	F ? . I L C N P . K	—— junceum.
. . 2 . 4 5	0 1 . 3 . . . . 8 .	50	F . . I L C N P . K	—— aristatum.
. . . . 4	. . . .	50	F A G I . C . P . K	—— falcatum.
. . . .	. . . .	.	. . . ? L C N . . .	—— neglectum.
. . 2 3 4 5 . . 8 .	. 1 2 3 4 5 6 7 . .	.	F A G I L C ? P S K	—— ranunculoides.
. . . .	. . . .	50	F . . I . . N P . K	—— gramineum.
. . . 3 4 5	. 1 . . 4 . . 7 . .	.	F . G I L C . . . K	—— graminifolium.
. . 2 3 . 5 6 7 . 9	. . . 3	.	F A G I	—— stellatum.
. 1 . . 4 5 . . 8 9	0	50	F A G I L C N P . K	—— rotundifolium.
. . . .	. . . .	.	F A G ? ? C N P S K	Œnanthe fistulosa.
. . . . 4	0 1 . 3 . . 7 . . .	50	. . . I L C N P . K	—— pimpinelloides.
. . . . . 5 . . 8 .	. . . .	.	F A G I L C N P S K	—— Phellandrium.

	0									1										2									
	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
Œnanthe crocata, *Linn.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.
Æthusa Cynapium, *Linn.*	1	.	.	4	.	.	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
Seseli elatum, *Linn.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	.	8	9
—— glaucum, *Jacq.*	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
—— tortuosum, *Linn.*	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
—— varium, *Trev.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
—— montanum, *Linn.*	.	.	.	.	.	.	7	.	.	.	1	.	.	.	.	6	.	.	.	.	.	.	.	4	.	6	7	.	.
—— annuum, *Linn.*	1	2	.	.	.	.	.	8	9	.	.	.	.	.	.	.	.	.	.	.	.	2	.	4	.	.	7	.	9
Libanotis montana, *All.*	1	2	.	.	.	.	.	8	.	.	1	.	.	4	5	6	7	8	9	.	.	.	.	4	5	.	.	8	9
—— ——, var. (L. athamantoides. *DC.*)?.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	7	.	.	.	.	.	.	.	.	.	.	.	.
Cnidium apioides, *Spreng.*	.	.	3	4	.	6	.	.	.	.	.	.	.	.	.	6	.	8	.	.	.	2	3	4	.	.	7	.	.
Trochiscanthes nodiflorus, *Koch*	1	2	3	4	.	.	.	8	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Athamanta cretensis, *Linn.*	1	2	3	4	5	6	7	8	9	.	.	2	.	4	.	6	7	8	.	.	.	2	.	4	5	6	7	8	9
—— Matthioli, *Wulf.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ligusticum ferulaceum, *All.*	1	2	3	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	?	.	.	.
—— Seguieri, *Koch*	.	.	.	.	.	?	.	?	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.
Physospermum aquilegifolium, *Koch*	.	.	.	.	.	.	.	8	9	.	.	.	.	.	.	6	.	.	.	.	.	.	.	?	.	.	.	.	.
Silaus pratensis, *Bess.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Meum athamanticum, *Jacq.*	1	2	3	4	5	.	.	8	9	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7	.	.
—— Mutellina, *Gærtn.*	?	.	3	4	5	.	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	.	7	8	9
—— ——, var. (M. adonidifolium, *Gay*).	.	.	.	.	.	6	.	8	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gaya simplex, *Gaud.*	1	.	.	.	5	6	.	8	9	0	1	2	3	4	5	6	7	8	.	.	.	2	3	4	5	6	7	.	.
Selinum caruifolia, *Linn.*	.	.	.	.	.	.	.	8	.	.	.	.	.	.	.	6	.	.	.	.	.	2	3	4	.	6	.	.	.
Angelica sylvestris, *Linn.*	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
—— ——, var. (A. montana, *Schleich.*)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7	.	.	.	.	.	.	.	.	.	7	8	.
Archangelica officinalis, *Hoffm.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	.	.	.	.	.	.	.	4	.	.	.	.	.
Ferulago galbanifera, *Koch*	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9
Peucedanum officinale, *Linn.*	.	2	.	.	.	.	.	8	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	6	.	.	.
—— Chabræi, *Rchb.*	1	.	.	.	.	.	.	.	9	.	.	.	.	.	.	6	.	.	9	.	.	2	.	.	.	6	.	.	.
—— Schottii, *Bess.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
—— Cervaria, *Lapeyr.*	1	2	.	.	.	.	7	8	9	.	.	.	.	.	.	6	.	8	9	.	.	2	3	4	.	6	7	8	9
—— Onoselinum, *Moench*	1	2	3	4	.	.	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
—— venetum, *Koch*	.	2	.	.	.	.	.	?	.	.	.	.	.	4	.	.	.	.	9	.	.	2	.	4	.	6	7	8	.
—— austriacum, *Koch*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	5	.	.	.	.
—— rablense, *Koch*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	3	4	?	6	7	8	.
Tommasinia verticillaris, *Bert.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.
Thysselinum palustre, *Seg.*	.	.	.	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	4	.	.	.	.	.
—— ——, var. (T. Plinii, *Spreng.*)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9	.	.	.	.	.	.	.	.	.	.
Imperatoria Ostruthium, *Linn.*	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	.	4	5	6	7	8	9
—— angustifolia, *Bell.*	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pastinaca sativa, *Linn.*	1	2	.	.	5	6	7	8	9	.	.	2	.	4	.	6	7	8	9	0	.	2	.	4	5	6	7	8	9
—— ——, var. (P. opaca, *Bernh.*)	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Heracleum Sphondylium, *Linn.*	1	2	3	4	.	.	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
—— ——, var. (H. elegans, *Jacq.*)	.	?	3	.	.	.	.	8	.	.	.	2	.	.	.	6	.	8	9	.	.	.	.	.	.	.	.	.	9
—— sibiricum, *Linn.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	7	.	.	.	.	.	.	.	.	.	7	.	9
—— asperum, *Mert. & Koch*	.	.	3	.	.	.	.	8	?	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.	.	.
—— alpinum, *Linn.*?	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.
—— Pollinianum, *Bert.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.
Tordylium maximum, *Linn.*	1	.	.	4	.	.	.	8	9	.	.	.	.	.	.	6	.	.	9	.	.	.	.	4	.	.	.	.	.
Siler trilobum, *Scop.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Laserpitium latifolium, *Linn.*	1	.	3	4	5	.	7	8	9	0	1	2	.	4	5	6	7	8	9	0	1	2	.	.	5	6	7	8	9
—— Gaudinii, *Moretti*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	3	.	5	6	7	8	9
—— Siler, *Linn.*	.	2	.	.	.	.	7	8	.	.	1	2	.	4	.	6	.	8	.	0	1	2	.	4	5	6	7	8	9
—— peucedanoides, *Linn.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	6	7	8	9
—— hirsutum, *Lam.*	.	.	.	.	5	.	7	8	9	0	1	2	3	4	5	6	7	8	9	.	1	.	.	4	5	6	7	8	9
—— prutenicum, *Linn.*	.	.	.	.	.	6	.	8	9	.	.	.	.	.	.	6	.	.	9	0	.	.	.	.	.	6	7	8	9
—— gallicum, *Linn.*	1	2	3	4	5	6	7	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	?	.	.	.
—— nitidum, *Zanted.*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	6	7	.	9

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . .	. . . 3	.	. . . . ? . ?	Œnanthe crocata.
. . . 3 4 5 . 7 8 .	0 1 . 3 . 5 . 7 . .	.	F A G I L C N P S K	Æthusa Cynapium.
0 . 2 . 4 5	0 1 2 3 4 5 6 7 8 9	50	. . . I	Seseli elatum.
. . . . ? ?	. . . .	.	. . G I . . . . . K	—— glaucum.
. . . .	. . . .	.	. . . I L C N P . K	—— tortuosum.
. . . . 7 . .	. . . .	.	. . G I . . . . . K	—— varium.
. . . . 4	0 . . . . . . 7 . .	50	F A . I L C N P . K	—— montanum.
. . 2 3 4 5 . 7 8 9	0 1 2 3 . 5	50	F A G ? L C ? P . K	—— annuum.
. 1 . . 4 5 6 7 8 9	0 1 . . 4 5 . 7 . .	50	F A G I ? C N P S K	Libanotis montana.
. . . .	. . . 3 . . . 7 . .	.	F . . I . . N . . K	—— ——, var. (L. athamantoides).
. . . .	. . . 3 4	.	F . . I L C N . . K	Cnidium apioides.
. . . . 4	. . . .	.	F A . . L C	Trochiscanthes nodiflorus.
0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L ? . . . K	Athamanta cretensis.
. . . ? ? . . . . ?	. ? . 3 4 5 6 7 8 9	50	. . . I . ? . . . K	—— Matthioli.
. . . .	. . . .	.	F A	Ligusticum ferulaceum.
. . 2 . 4 . . . ? .	. . . . 4	50	. . . I . . . . . K	—— Seguieri.
. . . .	. . . .	.	F . . . L C . P . .	Physospermum aquilegifolium.
. . . . ?	. . . .	.	F A G ? . . . P S K	Silaus pratensis.
. . . .	. . . . 7 . .	.	F A G . L C N P . K	Meum athamanticum.
0 . 2 3 4 . 6 7 8 9	. . . . 4 5	.	F A G	—— Mutellina.
. . . .	. . . .	.	F ?	—— ——, var. (M. adonifolium).
. . . 3 . . 6 7 8 9	. . 2 3 4	.	F A G . . . . . . K	Gaya simplex.
. . . . 4 . . . 8 .	0 . . . . . . 7 . .	50	F A G I . . . P S K	Selinum caruifolia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	.	F A G I L C ? P S K	Angelica sylvestris.
. . . . 4 . . 7 8 .	. . . .	.	F A G I L C N ? S K	—— ——, var. (A. montana).
. . . 3 4 5	. . . .	50	. A G . . C . . S K	Archangelica officinalis.
. 1 . . 4 5	0 1 . 3 . . . 7 . .	50	. . . I L C N . . K	Ferulago galbanifera.
. . . .	. . . 3	.	. A G . L C N . . K	Peucedanum officinale.
. . . . 4 5	0 1 . 3 . 5 6 7 . .	.	F A G I L C N P . K	—— Chabræi.
. . . .	. . . 3 . . . 7 . .	50	. . ? I	—— Schottii.
. 1 2 3 4 5 . 7 8 9	0 1 . 3 4 . . 7 . .	50	F A G I L C N P . K	—— Cervaria.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Onoselinum.
. 1 2 . 4 5 . 7 8 .	. 1 . 3 . . . 7 8 .	50	. . . I L C ? . . .	—— venetum.
. . 2 3	. . . 3 . . . 7 . .	50	. A G I . . . . . K	—— austriacum.
. . 2 . 4 5	. 1 . 3 4 . . 7 . 9	.	. . . I	—— rablense.
. 1 2 . . 5 . . 8 9	. . . 3 . 5	50	. A G I L C N . . .	Tommasinia verticillaris.
. . . . . 5 . 7 8 .	. . . 3	.	. A G I . . . P S K	Thysselinum palustre.
. . . .	. . . .	.	. . G	—— ——, var. (T. Plinii).
0 . 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 . .	.	F A G I L C ? P S K	Imperatoria Ostruthium.
. . . .	. . . .	.	. A	—— angustifolia.
. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	.	F A G I L C N P S K	Pastinaca sativa.
. . . . . 5 . 7 8 .	. . . 3	.	? . . I L C N ? S K	—— ——, var. (P. opaca).
0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 . . 7 . .	50	F A G I L C N P S K	Heracleum Sphondylium.
. . . . 4 . . . 8 .	0 . . . 4	.	. . G . ?	—— ——, var. (H. elegans).
0 . . . 4 9	0 1 . . 4	.	F A G I L ? . . S K	—— sibiricum.
. . 2 3 . 5 . . 8 9	. . . 3 9	.	F A G I ? C N P . K	—— asperum.
. . . .	. . . . . 5	.	. A G . . . . . . K	—— alpinum.
. . . 3 4 5 . . . 9	. 1 . . 4	.	. . . I . C . ? . .	—— Pollinianum.
. . . . . 5 . 7 . .	0 1 . 3	50	F A . I L C N P . K	Tordylium maximum.
. . . . . 5 . 7 . .	. . . .	.	F . G I . . . . . K	Siler trilobum.
0 1 2 3 4 5 . . 8 9	. 1 2 3 4 5 6 7 . 9	.	F A G I L C N P S K	Laserpitium latifolium.
. . . 3 4 5 6 7 8 .	. . . 3	.	. A . ?	—— Gaudinii.
0 1 2 3 4 5 . . 8 .	0 1 2 3 4 . . 7 8 .	50	F A G I L C N P . K	—— Siler.
0 1 2 3 4 5 . . . 9	0 1 2 3 4 5 6 7 . .	50	. . G I . . . . . K	—— peucedanoides.
. . . 3 . . 6 7 8 .	. . . . 7 . .	.	F A G I	—— hirsutum.
. 1 2 3 4 5 . 7 8 .	0 1 . 3 . . 6 7 . .	50	F A G I . . . P . K	—— prutenicum.
. . . .	. . . .	.	F . . . L C N P . ?	—— gallicum.
0 1 2 3	. . . .	.	. . . .	—— nitidum.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Orlaya grandiflora, *Hoffm.*	1 2 3 . . . 7 8 9	. . . . . . 6 . . 9	. . 2 . 4 . 6 7 8 9
—— platycarpos, *Koch*	. . . .	. . . .	. . 2 . . . .
Daucus Carota, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Caucalis daucoides, *Linn.*	1 2 3 4 . . . 8 9	. . 2 . 4 . 6 . . 9	. . 2 . 4 . . . 8 .
—— leptophylla, *Linn.*	1 2 3 4	. . . .	. . . . 4 . . . . .
Turgenia latifolia, *Hoffm.*	. . . . 8 .	. . . . 4	. . . . 8 .
Torilis Anthriscus, *Gærtn.*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— helvetica, *Gmel.*	. . . . 8 .	. . . .	. . . . 7 8 .
—— nodosa, *Gærtn.*	1 2	. . . .	. . 2 . . . . 7 8 .
Scandix Pecten-Veneris, *Linn.*	1 2 3 . 5 . . 8 9	. . . 3 . . 6 . . 9	. . 2 . 4 . . 7 8 9
Anthriscus sylvestris, *Hoffm.*	1 2 3 4 . . . 8 9	0 . . . 4 . 6 7 8 9	. . 2 . 4 5 6 7 8 9
—— Cerefolium, *Hoffm.*	. . . .	. . . .	. . . . 4 . . 7 . .
—— vulgaris, *Pers.*	1 2 . . 5 6 . . .	. . . .	. . 2 . 4 5 6 . . .
Chærophyllum temulum, *Linn.*	1 2 . . . . 7 . 9	. . . . 7 . .	. . 2 . . . 6 7 8 9
—— aureum, *Linn.*	1 . 3 . 5 6 . 8 .	. . 2	 9
—— elegans, *Gaud.*	. . . .	. . . . . . 6 . . .	. . . .
—— Villarsii, *Koch*	1	. . . . 4	. . . . ?
—— hirsutum, *Linn.*	. 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9
—— aromaticum, *Linn.*	. . . .	. . . .	. . . .
Myrrhis odorata, *Scop.*	1 2 3 . . 6 . . 9	. . . . 7 . 9	. . 2 . 4 5 . 7 8 .
Molopospermum cicutarium, *DC.*	1 2 . . . . . 8 9	. . . . . . 6 . . 9	. . 2 3 4 . 6 7 8 9
Conium maculatum, *Linn.*	1 2 3 4 . . . 8 .	. 1 . 3 . . 6 . 8 9	. 1 2 . 4 . . 7 8 .
Cachrys lævigata, *Lam.*	. 2	. . . .	. . . .
Pleurospermum austriacum, *Hoffm.*	. . . . . . 7 8 9	. . . . . . 6 . . .	. . 2 3 . . 6 7 . .
Malabaila Hacquetii, *Tausch*	. . . .	. . . .	. . . .
Bifora radians, *Bieb.*	. . . .	. . . .	. . . . 4 9
Hedera Helix, *Linn.*	1 2 3 4 5 . 7 8 9	0 . . . 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Cornus sanguinea, *Linn.*	1 2 3 4 . . 7 8 9	. . 2 . 4 5 6 7 8 9	. . 2 . 4 5 6 7 8 9
—— Mas, *Linn.*	. . . 4 . . . 8 9	. . . . 4 . 6 . . 9	0 1 2 . . . 6 7 8 9
Viscum album, *Linn.*	1 2	. . . . . . 6 . 8 .	. . 2 . 4 . . 7 . .
Adoxa moschatellina, *Linn.*	. 2 . . . 6 7 8 .	. . 2 . 4	. . 2 . . . . . 8 9
Sambucus Ebulus, *Linn.*	1 2 3 4 . . 7 8 9	0 1 . . 4 . 6 . . 9	. . 2 . 4 5 6 7 8 .
—— nigra, *Linn.*	1 2 3 4 . . 7 8 9	0 . 2 3 4 . 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— racemosa, *Linn.*	1 2 3 . . . . 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Viburnum Lantana, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 . 9	. . 2 . 4 5 6 7 8 9
—— Opulus, *Linn.*	1 . . 4 5 . . 8 .	. . . . 4 . 6 . . .	. . 2 . 4 . 6 7 8 .
Lonicera Caprifolium, *Linn.*	1 . . 4 . . . 8 9	. . . . . . 6 . . 9	. . 2 . . . . 7 8 .
—— Periclymenum, *Linn.*	. . . . 8 .	. . . . 4	. . . .
—— Xylosteum, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— nigra, *Linn.*	1 2 3 4 5 . . 8 .	. . . . . . 6 . 8 9	. . 2 . . 5 . 7 8 9
—— cærulea, *Linn.*	. . . . 8 9	. 1 2 3 4 5 6 7 8 9	. . . . 4 5 . 7 8 9
—— alpigena, *Linn.*	1 . 3 4 5 . 7 8 9	. 1 . . . . 6 7 8 .	. 1 2 . 4 5 6 7 8 9
Linnæa borealis, *Gron.*	. . . .	0 . 2	0 . . 3 4 5 . . 8 .
Sherardia arvensis, *Linn.*	1 2 3 4 . . 7 8 9	. . . . . . 6 . . 9	. . 2 . 4 5 6 7 8 9
Asperula arvensis, *Linn.*	. 2 . 4 . . . 8 .	. . 2 . . . 6 . . .	. . 2 . 4 . . . . .
—— taurina, *Linn.*	. 2 3 4 . 6 7 8 9	. 1 2 . . . 6 7 . .	. . 2 . 4 . . 7 8 .
—— cynanchica, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— ——, var. (A. longiflora, *Waldst. & Kit.*)	1 2 3 4 . 6 . . 9	. . . .	. . 2 . . . 6 . . .
—— odorata, *Linn.*	. 2 3 4 . 6 7 8 9	. 1 . . . . 6 . . 9	. . 2 . 4 . 6 7 8 9
—— hexaphylla, *All.*	1 2	. . . .	. . . .
Rubia peregrina, *Linn.*	1 2 . . . . . 8 .	. . . .	. . . . ? . . . . .
Crucianella angustifolia, *Linn.*	. . . . 8 .	. . . .	. . . .
Galium cruciatum, *Sm.*	1 2 . . 5 . 7 8 9	. 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9
—— vernum, *Scop.*	1 2 3 4 5 . 7 . 9	0 . 2 . 4 5 6 7 8 9	. . 2 . . . 6 7 8 9
—— pedemontanum, *All.*	. . . . 5 6 7 8 9	. . . . 4 . 6 . . .	. . 2 3 4 . . . . .
—— tricorne, *Linn.*	1 2	. . . .	. . . .
—— Aparine, *Linn.*	1 2 3 4 . . 7 8 9	. 1 2 3 4 . 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— spurium, *Linn.*	. . . . 8 .	. . . . . . 6 . . .	. . . .
—— parisiense, *Linn.*	1 2 3 4 5 . . 8 .	. . . . . . 6 . . .	. . . . 7 8 .
—— saccharatum, *All.*	1 2	. . . . . . ? . . .	. . . .

3 (0 1 2 3 4 5 6 7 8 9)	4 (0 1 2 3 4 5 6 7 8 9)	50	F A G I L C N P S K	
0 1 2 . 4 5 6 7 8 .	0 1 . 3 4 . . . 8 .	50	F A . I L C N P . K	Orlaya grandiflora.
. . . .	. . . .	50	. . . I L C N . . .	—— platycarpos.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Daucus Carota.
. 1 . 3 4 5 6 . . 9	0 1 . 3 4 . . 7 . .	50	F . . I L C N P . K	Caucalis daucoides.
. . . .	. . . . 7 . .	50	F A . . . . N . . .	—— leptophylla.
. . . . 4	0	.	F A . I L C N P . K	Turgenia latifolia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I ? C N P S K	Torilis Anthriscus.
. . . . . 5	. . . 3	.	? A G . L C N ? . K	—— helvetica.
. 1 . . 4 5	0 . 2 3	50	F . . I L C N P . K	—— nodosa.
. . 2 . 4 5	0 1 2 3 4 5	50	F A G I L C N P ? K	Scandix Pecten-Veneris.
0 1 2 3 4 5 . 7 . 9	0 1 2 3 4 . 6 7 8 .	50	F A G I L C N P S K	Anthriscus sylvestris.
. . . . ? 5 . 7 . .	. . . . 8 .	50	? . . . . C N P S K	—— Cerefolium.
. . . . 4 ?	0 1 2	.	F A G I ? C N P S K	—— vulgaris.
0 . . 3 4 5 . 7 . .	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	Chærophyllum temulum.
. . . . 4 . . 7 8 9	. 1 . 3 4 . . 7 . .	.	F A . I L C N P . K	—— aureum.
. . . .	. . . .	.	. A G	—— elegans.
? . . 3 4 . . 7 8 .	. . 2 3 . 5 . 7 . .	.	F A G . . . . . . K	—— Villarsii.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— hirsutum.
. . . . 9	. . . .	.	. . G . . C . . . K	—— aromaticum.
0 . 2 3 4 5 6 . . .	0 1 2 3 4 5 . 7 . 9	.	F A G I L C . P S K	Myrrhis odorata.
0 1 2 3 4 5	0 1 2 3 . . 6 7 8 .	50	F A . I L . . P . .	Molopospermum cicutarium.
0 1 . 3 . 5 . 7 8 .	0 1 . 3	50	F A G I L C N P S K	Conium maculatum.
. . . .	. . . .	.	. . . .	Cachrys lævigata.
0 . . ?	0 1 . 3 . . 6 7 . 9	.	F A G I . . . . . K	Pleurospermum austriacum.
. 1 . . 4	. . . . 8 .	50	. . . I . . N . . .	Malabaila Hacquetii.
. . . . 4 5 . 7 8 .	0 1 . 3	.	. . . I L C . . . K	Bifora radians.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	Hedera Helix.
0 1 2 3 4 5 6 . . 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Cornus sanguinea.
0 1 2 . 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— Mas.
. . . . 4 5 . . 8 .	0 1 . 3 . . . 7 . .	.	F A G I L C N P S K	Viscum album.
. . . 3 4 5 . 7 8 9	0 1 . 3 . . . 7 . .	50	F A G I L C N P S K	Adoxa Moschatellina.
0 1 2 3 4 5 . . 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Sambucus Ebulus
0 1 2 3 4 5 6 . 8 .	0 1 2 3 4 . . 7 8 9	50	F A G I L C N P S K	—— nigra.
0 . 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 8 .	50	F A G I L C ? P . K	—— racemosa.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	Viburnum Lantana.
. 1 . 3 . 5 6 . 8 .	0 1 . 3 . . . 7 . 9	50	F A G I L C N P S K	—— Opulus.
0 1 2 . 4 5	0 1 . 3 . . . 7 8 9	50	. A G I L C N P . K	Lonicera Caprifolium.
. . . . 4	. 1 . 3	50	F A G ? L C N P S K	—— Periclymenum.
0 1 2 3 4 5 6 . 8 .	0 1 2 3 4 . 6 7 8 9	50	F A G I L C N P S K	—— Xylosteum.
. . . . . 5 6 7 8 9	. 1 . 3 4 5	.	F A G I . . . P . K	—— nigra.
0 . 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 8 9	.	F A G I . . . P S K	—— cærulea.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	50	F A G I L C N P . K	—— alpigena.
. . . 3 . . ; 7 8 .	. . . .	.	. A G . . . . . S .	Linnæa borealis.
0 1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 . 7 . 9	50	F A G I L C N P S K	Sherardia arvensis.
0 . 2 3 4 5	0 1 2 3	50	F A . I L C N P . K	Asperula arvensis.
. 1 . . 4 5 6 . . .	0 1 2 3 4 . . 7 8 .	50	F A G I L C N . . K	—— taurina.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	50	F A G I L C N P . K	—— cynanchica.
. 1 2 . 4 5 6 . 8 .	. . . 3 4 5 . 7 . 9	50	F A G I ? C N . . K	—— ——, var. (A. longiflora).
0 . . 3 4 5 . 7 . .	0 1 2 3 . . . 7 8 9	50	F A G I L C N P S K	—— odorata.
. . . .	. . . .	.	. . . .	—— hexaphylla.
. 1	. . . .	.	. . . I L C N P . K	Rubia peregrina.
. . . .	. . . .	.	. . . I L C N P . .	Crucianella angustifolia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P . K	Galium cruciatum.
0 1 2 . 4 5 . . 8 9	0 1 2 3 4 5 . 7 8 .	50	F . G I L C N P . K	—— vernum.
. . . . . 5	0 . . 3	.	. A . I . . N . . K	—— pedemontana.
. . . . 4 5	0 1 . 3	.	? A . I L C N P . K	—— tricorne.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Aparine.
. . . . 7 8 .	. . . 3	.	. A . . . . . . S K	—— spurium.
. . . . 4 5	0 . . 3 . . . 7 . .	.	F A . I L C N P . K	—— parisiense.
. . . .	. . . .	.	. . . I L C N . . .	—— saccharatum.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Galium uliginosum, *Linn.*	. . . . . . 7 . 9	. . . . . . ? . . .	. . . .
—— palustre, *Linn.*	1 2 3 4 . . . 8 9	. . . . 4 . 6 . . 9	0 1 2 . 4 . 6 7 8 .
—— rotundifolium, *Linn.*	. 2 3	. 1	. . . .
—— boreale, *Linn.*	1 2 3 . . 6 7 . .	. . . . 4 5 . . 8 9	. . 2 . . . .
—— verum, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 . 2 3 4 5 6 7 8 9
—— purpureum, *Linn.*	1 2 3 4 5 . . 8 9	. . . . 4 . 6 . . 9	0 . 2 . 4 . 6 7 8 9
—— sylvaticum, *Linn.*	. . 3 . 5 6 7 8 9	0 1 2 . 4 5 6 7 . 9	0 1 2 . 4 5 6 7 8 9
—— ——, var. (G. aristatum, *Linn.*)?	1 2 . 4 . . . 8 .	. 1 . . . . 6 . . .	. . 2 . . . . 7 8 .
—— Mollugo, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 . 2 . 4 5 6 7 8 9
—— erectum, *Huds.*	1 2 3	. . . .	. . . . 4 . . . . .
—— corrudæfolium, *Vill.*	1 2 3 4 . 6 . 8 9	. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— cinereum, *All.*	1 2	. . . . 4	. . . . 7 . .
—— rubrum, *Linn.*	1 2 3 4 5 6 7 8 9	0 . 2 . 4 5 6 . 8 9	. . 2 3 4 5 6 7 8 9
—— obliquum, *Vill.*	1 2 3 4	. . . .	. . 2 . 4 . . . . .
—— saxatile, *Linn.*	1 . . . . . 7 8 .	. ? . . . 5	. . . .
—— sylvestre, *Pollich*	1 . . . . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9
—— ——, var. (G. læve, *Thuill.*)	. 2 . . . . . 8 .	. 1 . 3 . . 6 . 8 .	. . . .
—— pumilum, *Lam.*	. . . . . . 7 8 .	. . . .	. . . .
—— megalospermum, *Vill.*	1 2 . . . . 7 8 .	. . . .	. . . . 4 . . 7 8 .
—— Tendæ, *Reichb. fil.*	1 2 3 4	. . . .	. . . .
Valeriana officinalis, *Linn.*	1 . 3 4 5 . 7 8 9	0 1 2 . 4 . 6 7 8 9	0 1 2 . 4 5 . 7 8 9
—— ——, var. (V. sambucifolia, *Mikan*).	. . . .	. . . .	. . . .
—— dioica, *Linn.*	. . . . 8 9	. . . . . . 6 . . 9	. . 2 . 4 . . 7 8 9
—— tuberosa, *Linn.*	1 . . . . . . 8 .	. . . .	. . . .
—— tripteris, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— montana, *Linn.*	1 2 3 4 . . 7 8 9	. 1 2 . . . 6 7 8 .	. 1 . . 4 5 . 7 8 9
—— supina, *Linn.*	. . . .	. . . .	. . . . 4 5 . . 8 .
—— saliunca, *All.*	1 2 . . . 6 7 . .	. . 2 . . . 6 7 8 .	. . . .
—— saxatilis, *Linn.*	1 . . 4	. . . .	. . 2 . . 5 6 7 8 9
—— elongata, *Linn.*	. . . .	. . . .	. . . .
—— celtica, *Linn.*	. . . . 8 9	0 1 2 3 4 5 6 7 8 .	. . . .
Centranthus ruber, *DC.*	1 2 . 4	. . . .	. . 2 . 4 . 6 7 8 .
—— angustifolius, *DC.*	1 . 3 4 . 6 7 . .	. . . .	. . . .
Valerianella olitoria, *Pollich*	. . . 4 5 . . 8 9	. . . .	. . 2 . 4 . 6 . 8 9
—— carinata, *Lois.*	?	. . . .	. . . .
—— echinata, *DC.*	1	. . . .	. . . .
—— Morisonii, *DC.*	1	. . . .	. . . .
—— Auricula, *DC.*	1	. . . .	. . . .
—— coronata, *DC.*	. 2 . . . . . 8 .	. . . .	. . . .
Dipsacus sylvestris, *Mill.*	1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— pilosus, *Linn.*	. 2 3 . 5 6 . 8 9	. . . 3 4 . 6 . . .	. 1 2 . 4 5 . . 8 .
Cephalaria alpina, *Schrad.*	. 2 3	. . . .	. . . .
—— transylvanica, *Schrad.*	1 . . . . 6 . ? .	. . . .	. . . .
—— leucantha, *Schrad.*	1 2	. . . .	. . . .
Knautia hybrida, *Coult.*, var. integrifolia.	. . . .	. . . .	. . . . . . 6 7 8 .
—— longifolia, *Koch*	. . . .	. . . .	. . . . 7 . 9
—— sylvatica, *Dub.*	1 2 3 . . . 7 8 9	0 . . . . . 6 7 8 .	0 1 2 3 4 5 . 7 8 9
—— arvensis, *Coult.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 . . 9	0 . 2 3 4 5 6 7 8 9
Succisa pratensis, *Moench*	1 2 . . 5 . 7 8 9	. 1 2 . 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
Scabiosa gramuntia, *Linn.*	1 . 3 4 . . . 8 9	. . . . 4	. . . . . 5 6 7 8 .
—— ——, var. (S. pyrenaica, *DC.*)	1 2	. . . .	. . . . . . 6 . . .
—— Columbaria, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— lucida, *Vill.*	. . . . . . 7 8 9	0 1 2 . 4 5 6 7 8 .	. . . 3 . 5 6 7 8 9
—— ——, var. villosa, *Rota*	. . . .	. . . .	. . . . 7 . .
—— maritima, *Linn.*	. . . . 8 .	. . . .	. . . .
—— suaveolens, *Desf.*	. . . .	. . . .	. . . . . . 6 . . .
—— ——, var. (S. vestina, *Facch.*)	. . . .	. . . .	. . . . 8 9
—— argentea, *Linn.*	. . . .	. . . .	. . . .

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . . 7 8 9	. . . 3	.	F A G ? . . . P S K	Galium uliginosum.
0 . 2 3 4 5 6 . 8 9	0 . 2 3 4 5 . 7 . .	50	F A G I L C N P S K	—— palustre.
. . . . . 5	. . . .	50	F A G I L C N P S K	—— rotundifolium.
. . . . . 5 6 7 8 9	. . 2 . . 5 . . 8 .	.	F A G ? . . . P S K	—— boreale.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— verum.
0 1 2 3 4 5 . . 8 9	0 1 2 3 4 5 6 7 8 9	50	F ? . I L C . . . K	—— purpureum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	. A G I L C N P . K	—— sylvaticum.
. . 2 3 4 5 . . 8 .	. . . 3 . 5	.	F . G . . . . . . K	—— ——, var. (G. aristatum).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Mollugo.
. . 2 9	. . . 3	.	F A G I L C N P S K	—— erectum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A . I L C N P . K	—— corrudæfolium.
. . 2 . 4 5	0	.	. . . I L C N . . .	—— cinereum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . .	50	F ? . . L C . P . K	—— rubrum.
. . . . 4 . . . 8 9	. . . .	.	F . . ? L C N . . .	—— obliquum.
. . . ? . 5	. . . .	.	F A G I . . . P S .	—— saxatile.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	.	F A G I L . . P S K	—— sylvestre.
. . . 3 4 5 . . 8 9	. . . 3 . . 6 . . .	.	F A G . L C N P . .	—— ——, var. (G. læve).
. . . . ? .	. . . .	.	F . G . . . . . . K	—— pumilum.
0 1 2 3 4 5 6 . . 9	. . 2 3 4 . 6 . . .	.	F A G . ? ? N ? . .	—— megalospermum.
. . . .	. . . .	.	. . . .	—— Tendæ.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Valeriana officinalis.
. . . . 8 .	. . . .	.	. . G . . . . . S K	—— ——, var. (V. sambucifolia).
0 . 2 3 4 5 6 7 8 9	0 . 2 3 4 5 . 7 . .	50	? A G I . C . . S K	—— dioica.
. . . . ?	. . . .	.	F . . I L . N P . .	—— tuberosa.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P . K	—— tripteris.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . .	.	F A G I . C N P . K	—— montana.
. . . . 8 9	. . . . 4 5	.	. A G I	—— supina.
. . . . 8 .	. . . .	.	F A ? . . . N . . .	—— saliunca.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	. A G I . C N . . K	—— saxatilis.
. . . . 8 9	. . . 3 4 5	.	. . G I . . . . . K	—— elongata.
. . . ? . . . ? . .	. . . .	50	F A G I	—— celtica.
. 1 2 3 4 5 . 7 . .	0	.	F A . I L C N P . .	Centranthus ruber.
. . . . . 5	. . . .	.	F A G . . . . P . .	—— angustifolius.
0 1 2 3 4 5 6 . . 9	0 1 2 3 . . . 7 8 .	50	F A G I L C N P S K	Valerianella olitoria.
. . . . . 5 . . 8 .	. . . .	.	? . ? . . C N P . K	—— carinata.
. . . .	0	.	. . . I	—— echinata.
0 1 2 . 4 5 6 7 8 9	0 1 2 3 . 5	50	F A G I L C N P S K	—— Morisonii.
. . 2 . 4 5 . . . 9	. . . .	.	? . G . . . . ? . ?	—— Auricula.
. . . . 4 5	0 1	50	F . . I L . . P . K	—— coronata.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P . K	Dipsacus sylvestris.
. . . . 4 5	0 1 2 3 . . . 7 . .	50	. A G I . . . P S K	—— pilosus.
. . . .	. . . . ? . .	.	F A	Cephalaria alpina.
. . . .	0	.	. . . I L C N . . .	—— transylvanica.
. . . .	. . . .	.	F . . I L C N P . .	—— leucantha.
. . . .	. . . . 7 . .	.	. . . I L C N . . .	Knautia hybrida, var. integrifolia.
0 . 2 3 4 5 6 7 8 9	. . . 3 4 5 . 7 . .	50	. A G . . . . P . .	—— longifolia.
0 1 2 3 4 5 . . 8 .	0 1 2 3 4 . . 7 8 9	50	F A G I L C N P . K	—— sylvatica.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P S K	—— arvensis.
0 . 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 . . .	.	F A G I L C ? P S K	Succisa pratensis.
. . 2 . 4 5 . 7 8 9	0 . . 3	.	F . G I L C N P . K	Scabiosa gramuntia.
. . 2	. . . .	.	. . . . L . . P . .	—— ——, var. (S. pyrenaica).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Columbaria.
0 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 . .	.	F A G I L C ? P . K	—— lucida.
. . . .	. . . .	.	F . . . . . . P . .	—— ——, var. villosa.
. . . .	. . . .	.	. . . . L C N . . .	—— maritima.
. . . .	. . . .	.	F A . I . . N . S K	—— suaveolens.
0 1 . . . 5 . . 8 .	. . . .	.	. . . ?	—— ——, var. (S. vestina).
. . . .	. . . . 7 . .	.	. . . I L . N . . .	—— argentea.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Scabiosa graminifolia, *Linn.*	1 2 3	. . . . 8 .	. . 2 . 4 . 6 7 8 .
—— ——, var. viridis, *Reichb.*	. . . 4	. . . .	. . . .
Eupatorium cannabinum, *Linn.*	1 2 3 4 . . 7 8 9	. . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Adenostyles albifrons, *Reichb.*	1 2 3 . . . 7 8 .	. 1 2 . 4 . 6 7 8 9	. . 2 . 4 5 . 7 . 9
—— alpina, *Bluff et Fing.*	1 2 3 4 5 . 7 8 9	0 1 2 3 . 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— leucophylla, *Reichb.*	1 2 3 4 5 . 7 8 .	. 1 . . . . 6 . 8 .	. . . .
Homogyne sylvestris, *Cass.*	. . . .	. . . .	. . . .
—— alpina, *Cass.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— discolor, *Cass.*	. . . .	. . . . 8 .	. . . .
Tussilago Farfara, *Linn.*	1 2 3 4 . 6 7 8 9	. 1 2 3 4 5 6 7 8 .	0 . 2 . 4 5 6 7 8 9
Petasites officinalis, *Moench*	1 2 3 4 . 6 . 8 9	. . . 3 4 5 6 . 8 9	. . 2 . 4 5 6 7 8 .
—— albus, *Gærtn.*	1 2 . . . . 7 8 .	. . 2 . . . 6 . 8 .	. 1 2 . 4 . 6 7 8 9
—— niveus, *Baumg.*	1 2 3 . . . 7 8 .	. 1	. . . . 4 5 6 7 8 9
Linosyris vulgaris, *Cass.*	1 . . . . 6 7 8 9	. . . . 4 9	0 . 2 9
Aster alpinus, *Linn.*	1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9
—— Amellus, *Linn.*	1 2 3 . . . . 8 .	. . . . . . 6 . . 9	. . 2 3 4 . 6 7 8 .
—— ——, var. (A. pseudoamellus, *DC.*)?	. . . .	. . . .	. . . . 8 .
Bellidiastrum Michelii, *Cass.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Bellis perennis, *Linn.*	1 2 3 4 5 . 7 8 9	. 1 . . . . 6 7 8 9	. . 2 3 4 5 6 7 8 9
Stenactis annua, *Nees*	. . . .	. . . . 7 . .	0 1 . . . . 6 7 8 9
Erigeron canadensis, *Linn.*	1 2 . 4 . . . 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— acris, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (E. drœbachensis, *Mill.*).	. . . .	. . . .	. . . . 8 .
—— Villarsii, *Bell.*	1 2 3 . . 6 7 . .	0 . 2 . . 5 6 . . .	. . 2 . . 5 . . 8 .
—— alpinus, *Linn.*	1 2 3 . 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— uniflorus, *Linn.*	1 2 3 4 5 6 . 8 .	0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 9
—— ——, var. (E. glabratus, *Hoppe*).	1 . . . . . . 8 .	. . . 3	. . . . . 5 . 7 8 .
Solidago Virgaurea, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9
—— ——, var. (S. alpestris, *W. & K.*).	. . 3 . . . 7 8 9	. 1 . 3 . . 6 . 8 .	0 . . . 4 . . 7 8 9
—— ——, var. (S. pygmæa, *Bert.*)	. . . .	 9	. . . .
Micropus erectus, *Linn.*	1 . . 4 . 6 7 8 .	. . . . 4	. . . . 8 .
Telekia speciosissima, *Less.*	. . . .	. . . .	. . 2 . 4 . 6 7 8 9
Buphthalmum salicifolium, *Linn.*	1 2 3 4 5 . 7 8 9	. . 2 . 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Pallenis spinosa, *Cass.*	1 2	. . . .	. . . .
Inula ensifolia, *Linn.*	. 2 . . 5 . . 8 .	. . . .	. . 2 . . . 6 . . 9
—— salicina, *Linn.*	1	. . . . . . 6 . . .	. . 2 . . . . 7 8 9
—— squarrosa, *Linn.*	1 2 . . . . . 8 .	. . . . 4	. . 2 . . . 6 7 8 9
—— hirta, *Linn.*	1 2 . 4 . . 7 . .	 9	. . 2 . . . 6 7 8 .
—— Vaillantii, *Linn.*	. 2 3	. . . .	. . . .
—— Conyza, *DC.*	1 2 3 4 . . 7 8 9	. 1 . . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— odora, *Linn.*	1 2 3	. . . .	. . . .
—— britannica, *Linn.*	. . . .	. . . .	. . 2 . . . 6 . . .
—— Pulicaria, *Linn.*	 9	. . . . . . 6 . . 9	. . 2 . . . 6 . . .
—— dysenterica, *Linn.*	1 2 3 4 . . . 8 9	. . . . 4 5 6 . . .	. . 2 . 4 . 6 7 8 .
—— montana, *Linn.*	1 2 3 4 . . 7 8 .	. . . . 4	. . . . ? . .
—— bifrons, *Linn.*	1 2	. . . .	. . . . . . ? . . .
Phagnalon sordidum, *Reichb.*	1 2	. . . .	. . . .
Bidens tripartita, *Linn.*	. . . . . . 7 8 9	. . . . 4 5 6 . 8 9	. . 2 3 4 . 6 7 8 .
—— cernua, *Linn.*	. . . . 5	. . . . . . 6 . . 9	. . 2 3 4 . 6 7 8 .
—— bipinnata, *Linn.*	. . . .	. . . .	. . . . 8 9
Carpesium cernuum, *Linn.*	. . . 4	. . . . 4 . 6 . . .	. . 2 . . . . 7 8 9
Filago germanica, *Linn.*	1 2 . 4 . . 7 8 9	0 1 2 . 4 . 6 7 8 .	. . 2 3 4 5 6 7 8 .
—— ——, var. (F. pyramidata, *Vill.*).	. . . .	. . . .	. . . . 8 .
—— arvensis, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	. . . . 4 5 . 7 8 .
—— minima, *Pers.*	. . . . 8 9	. . . . 7 . ?	. 1 2 3 . . . 7 8 .
—— gallica, *Linn.*	1 2 . . . . . 8 .	 9	. . 2 . 4 . . 7 8 .
Gnaphalium sylvaticum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 . 7 8 9

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
0 1 2 3 4 5	0 1 2 3 4 5 6 7 8 .	50	F . . I L C N . . .	Scabiosa graminifolia.
. . 2 . 4 5	. . . . . 5	.	. . . . ? . N . . .	—— ——, var. viridis.
0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9	50	F A G I L C N P S K	Eupatorium cannabinum.
0 . 2 3 4 5 6 . 8 9	. 1 . 3 4 5 . 7 . .	.	F A G I L C N P . K	Adenostyles albifrons.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N . . K	—— alpina.
. . . .	. . . .	.	F A . . L . . . . K	—— leucophylla.
. . . .	. . . . 7 8 .	.	. . G I	Homogyne sylvestris.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C . P . K	—— alpina.
. . . . 4 9	. . . . 4 5 6 7 . 9	.	. . G I . . . . . K	—— discolor.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P S K	Tussilago Farfara.
. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P S K	Petasites officinalis.
0 . . 3 4 5 6 7 8 9	0 1 2 3 4 . . 7 8 .	.	F A G I L C N . S K	—— albus.
. . 2 . 4 5 . 7 8 9	0 1 . 3 . . . 7 8 .	50	F A G I . . . P . K	—— niveus.
. 1 . . 4 5 . 7 8 .	0 1 . 3 . 5 . 7 . .	.	F A ? I L C N P S K	Linosyris vulgaris.
. . 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9	.	F A G I L C N P S K	Aster alpinus.
. 1 2 3 4 5 6 7 8 9	0 1 2 3 . 5 6 7 . .	.	F A G I L C ? P . K	—— Amellus.
. . . .	. . . .	.	. . . .	—— ——, var. (A. pseudo-amellus).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N . . K	Bellidiastrum Michelii.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Bellis perennis.
0 1 2 3 4 5 6 . . 9	0 1 2 3 4 5 6 7 8 9	50	F A . I . C	Stenactis annua.
0 1 . 3 4 5 6 7 8 .	0 1 . 3 . 5 . 7 8 .	.	F A G I L C N P S K	Erigeron canadensis.
. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— acris.
. . . . . 5 . . 8 .	. . . .	.	F A G . . . . . S K	—— ——, var. (E. drœbachensis).
. . . . 4 . . 7 8 9	. . . 3	.	F A G . . . . . . K	—— Villarsii.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— alpinus.
. . 2 3 . . 6 7 8 9	. . . 3 4 5 . 7 . 9	.	F A G . . . . P S K	—— uniflorus.
. . . . 4 . . . 8 9	. . . 3	.	F A G I . . . . . K	—— ——, var. (E. glabratus).
. . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	Solidago Virgaurea.
. . . . 4	0 . . . 4	.	F A G . . . . . . K	—— ——, var. (S. alpestris).
. . . . 4 . 6 . . 9	. . . 3 4	.	F ? ? . . C	—— ——, var. (S. pygmæa).
. 1	0 . . 3	50	F . . I L C N . . .	Micropus erectus.
0 1	. . . .	.	. . . .	Telekia speciosissima.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C . . . K	Buphthalmum salicifolium.
. 1 . . 4	0 1	.	. . . I L C N . . .	Pallenis spinosa.
. 1 2	0 . . 3 . 5 6 7 . .	50	. . . I . . . . . K	Inula ensifolia.
. 1 2 . 4 5 6 . 8 9	0 1 . 3 . . . 7 . .	50	F A G I L C N P S K	—— salicina.
. 1 2 . 4	0 1 . 3 . 5	50	F . . I L C . . . K	—— squarrosa.
0 1 2 . 4 5 . 7 8 9	0 1 . 3 . . . 7 8 .	50	. . . I L C N . . K	—— hirta.
. . . .	. . . .	.	F A	—— Vaillantii.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P . K	—— Conyza.
. . . .	. . . .	.	. . . I L C N . . .	—— odora.
. . . . 4 5 6 7 8 9	0 1 . 3	50	. A G I L C . . S K	—— britannica.
. . . . 4 5 . . 8 .	0 1 2 3	50	F A G I L C N P S K	—— Pulicaria.
. . 2 3 4 5 6 7 8 .	0 1 . 3 . 5	50	F A G I L C N P . K	—— dysenterica.
. . . .	. . . . ?	.	F A . I L C N P . .	—— montana.
. . . .	. . . .	.	F . . . L . . . . K	—— bifrons.
. . . .	. . . .	.	. . . I L C N P . .	Phagnalon sordidum.
. . 2 . 4 5 6 7 8 9	0 1 . 3 . 5	50	F A G I L C N P S K	Bidens tripartita.
. . 2 . 4 5 6 7 8 9	0 . . 3	.	F A ? I ? ? N P S K	—— cernua.
0 1 2 3 4 5 . . 8 .	0 1 . 3 4 5	.	. . . .	—— bipinnata.
. . 2 . 4 5 . . 8 .	0 1 . 3 . . . 7 . .	50	F A G I . C N P . K	Carpesium cernuum.
0 1 2 . 4 5 . 7 8 .	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P S K	Filago germanica.
. . . . . 5	. . . . 7 . .	.	F A . I L . N P . K	—— ——, var. (F. pyramidata).
0 . 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 8 .	.	F A G I ? C N P S K	—— arvensis.
. . . . . 5 . . 8 .	. 1 . 3	.	F A G I ? C N P S K	—— minima.
. . . .	. . . 3	.	F A . I L C N P . K	—— gallica.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	.	F A G I L C N P S K	Gnaphalium sylvaticum.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Gnaphalium Hoppeanum, *Koch*	. . . .	. . . . . ?	. . . . ? . . . . .
—— supinum, *Linn.*	1 . 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— uliginosum, *Linn.*	1 . . . . . 7 8 9	. . . . . . 6 . 8 9	. . 2 . 4 . 6 . 8 .
—— luteo-album, *Linn.*	1 2 . 4 . 6 . 8 9	0 1 . . 4 . . 7 8 9	. . 2 3 4 5 6 . 8 .
—— Leontopodium, *Scop.*	1 2 . . 5 6 7 8 9	0 1 2 . . 5 6 7 8 .	0 . 2 . 4 5 6 7 8 9
—— dioicum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 9
—— carpathicum, *Wahlenb.*	1 2 3 4 5 6 . 8 .	. 1 2 . 4 5 6 7 8 .	. 1 . . 4 5 . 7 8 9
Helichrysum angustifolium, *DC.*	1 2	. . . .	. . . . 4 . 6 . 8 .
Artemisia Absinthium, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 8 9
—— camphorata, *Linn.*	1 2 3 4	. . . .	. . 2 . . . 6 . 8 9
—— lanata, *Willd.*	. . . .	. . . .	. . . . ? . . . . .
—— pedemontana, *Balb.*	1 . . 4	. . . .	. . . .
—— glacialis, *Linn.*	. . . . 5 6 7 8 9	0 . 2 . . 5 6 7 . .	. . . . 4 . 6 . 8 .
—— mutellina, *Vill.*	1 . 3 . . 6 7 8 9	. 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 . . 8 .
—— ——, var. (A. Baumgarteni, *Bess.*).	. . . .	. . . .	. . . . 8 .
—— spicata, *Wulf.*	1 . . . . 6 7 8 9	. 1 2 . . 5 6 7 8 .	0 . . . 4 5 . 7 8 .
—— Villarsii, *Gren. & Godr.*	1 2 3 4 5 . . ? .	. ?	. . . . ? . . . . .
—— tanacetifolia, *All.*	. . . . . 6 7 . .	. . 2 . . . ? . . .	. . . .
—— chamæmelifolia, *Vill.*	1 2 . . . ? . . .	0	. . . .
—— pontica, *Linn.*	. 2	. . . .	. . . .
—— campestris, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .
—— nana, *Gaud.*	. . . .	. 1 2	. . . .
—— vulgaris, *Linn.*	1 2 3 . . . 7 8 9	0 1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— valesiaca, *Linn.*	. . . .	. . . . 4	. . . .
Tanacetum vulgare, *Linn.*	1 2 . . 5 . . 8 9	0 . 2 . 4 . 6 7 8 9	. . 2 3 4 . 6 7 8 .
Plagius virgatus, *DC.*	1 2	. . . .	. . . .
Santolina Chamæcyparissus, *Linn.*	. . . 4 . . . 8 .	. . . .	. . . .
Ptarmica vulgaris, *DC.*	. . . . . 6 . . 9	. . . . . . 6 . . 9	. . . . 4 . . . 8 .
—— Clavennæ, *DC.*	. . . .	. . . .	. . 2 3 4 . 6 7 8 9
—— Herba-rota, *DC.*	1 2 3 4 5 6 . 8 9	0 . 2 . . . ? . . .	. . . .
—— macrophylla, *DC.*	1 2 3 . . . 7 8 9	0 1 2 . . 5 6 7 8 9	. . 2 3 4 5 6 7 8 9
—— oxyloba, *DC.*	. . . .	. . . .	. . . . . 5 . . 8 .
—— atrata, *DC.*	. . . .	. 1 . 3 . 5 6 7 8 .	. . 2 . 4 5 . . 8 .
—— moschata, *DC.*	. . . . 5	. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .
—— ——, var. β hybrida, *Gaud.*	. . . .	. . . .	. . . .
—— nana, *DC.*	1 . 3 . 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 6 7 8 .
Achillea Ageratum, *Linn.*	1	. . . .	. . . .
—— tomentosa, *Linn.*	1 . 3 4 . . . 8 9	. . . . 4 . 6 . . 9	. . . . 4 9
—— Millefolium, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— lanata, *Spreng.*?	. ? . . . 6 7 . .	0 . . . . 5 6 7 8 9	. . 2 . 4 5 . . 8 .
—— tanacetifolia, *All.*	1 . 3 . 5 . 7 8 .	. . . . . . 6 . . 9	. 1 2 . 4 . 6 7 . .
—— nobilis, *Linn.*	. 2 3 4 . . 7 8 9	. . 2 3 4 5 . . 8 9	. . . . 7 8 .
—— odorata, *Linn.*	. . . .	. . . .	. . . . ? . .
Anthemis tinctoria, *Linn.*	. . . .	. . . . . . 6 . . 9	. . 2 . 4 . . . 8 9
—— ——, var. (A. discoidea, *Willd.*).	1 2 3	. . . .	. . . .
—— ——, var. (A. Triumfetti, *All.*)	. ? . . . 6 . 8 .	. . . .	. . 2 . . . .
—— altissima, *Linn.* (*Koch*)	1 . . . . . . 8 .	. . . . . . 6 . . .	. . . .
—— arvensis, *Linn.*	1 2 . 4 5 . . 8 9	0 . . . 4 5 6 7 8 9	0 . 2 3 4 5 6 7 8 9
—— Cotula, *Linn.*	1 2 3 4 5 . 7 8 9	. 1 . . 4	. . . . 4 5 · 7 8 .
—— montana, *Linn.*	1 2 3 . 5	. . . . . 5	. . . .
Matricaria Chamomilla, *Linn.*	1 2 . . . . . 8 9	. 1 2 . 4 . 6 . . 9	0 1 2 3 4 5 6 . . .
Leucanthemum vulgare, *DC.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— montanum, *DC.*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 . 9	0 1 2 3 . 5 6 7 . 9
—— coronopifolium, *Gren. & Godr.*	1 2 3 4 5 6 7 8 9	. . . . 8 .	. . . .
—— ——, var. ceratophylloides, *Gren. & Godr.*	1 2 . 4 5 . . 8 .	. . . .	. . . .
—— alpinum, *Lam.*	1 2 . . 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. cinereum, *Bert.*	1 2 3 4	. . . . 4	. . . .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . . 9	. . . 3 . . . 7 . .	.	. . G . . . . . . K	Gnaphalium Hoppeanum.
0 . 2 3 . . 6 7 8 9	. 1 2 3 4 5 . 7 . 9	50	F A G I ? C N P S K	—— supinum.
. . . 3 4 5 6 7 8 .	. 1 . 3	.	F A G I ? C N P S K	—— uliginosum.
. 1 2 . 4 5 . 7 8 .	0 1 . 3 . 5	.	F A G I L C N P ? K	—— luteo-album.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L . N P . K	—— Leontopodium.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	50	F A G I L C N P S K	—— dioicum.
0 . 2 3 4 5 6 7 8 9	. . 2 3 4 5 6 7 . .	.	F A G I . . . P S K	—— carpathicum.
. ?	?	.	. . . I L C N P . .	Helichrysum angustifolium.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	.	F A G I L C N P S K	Artemisia Absinthium.
0 1 2 . 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 .	50	F . . I L C N P . K	—— camphorata.
? . 2 3 . 5 . . 8 9	. . . . 4	.	. . . .	—— lanata.
. . . .	. . . .	.	. . . .	—— pedemontana.
. . . . ?	. . . ?	.	F A . . . . . P . K	—— glacialis.
. . . 3 . . . 7 8 9	. . . 3 4 5	.	F A G . . C . P . K	—— mutellina.
. . . .	. . . .	.	. . . . K	—— ——, var. (A. Baumgarteni).
. . . 3 . . . 7 8 9	. . . 3 4 . . 7 . .	.	F A G I . . N P . K	—— spicata.
. . . . 8 .	. . . .	.	F A . . . . N P . .	—— Villarsii.
. . . .	 9	.	F . . . . K	—— tanacetifolia.
. . . .	. . . .	.	F . . . . . . P . .	—— chamæmelifolia.
. . . .	. . . .	.	. A G . . . . . . K	—— pontica.
. . 2 3 4 5 6 7 8 9	0 1 . 3 . . . 7 . 9	.	F A G I L . . P S K	—— campestris.
. . . . 7 . .	. . . .	.	F A G	—— nana.
0 . 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P S K	—— vulgaris.
. . . .	. . . .	.	. A	—— valesiaca.
. . 2 3 4 5 . 7 8 9	0 1 . 3 4 5	50	F A G I L C N P S K	Tanacetum vulgare.
. . . .	. . . .	.	. . . . . ?	Plagius virgatus.
. . . .	. . . .	.	F A G I L C N P . .	Santolina Chamæcyparissus.
. . . . . . 6 . . .	. . . .	.	F A G ? . . . P S K	Ptarmica vulgaris.
0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 . 9	50	. A G I . . . . . K	—— Clavennæ.
. . . .	. . . .	.	F . . . L	—— Herba-rota.
. . 2 3 . . . 7 8 9	. . . 3 4 5 . 7 . .	.	F A G . L	—— macrophylla.
0 . 2 3 4 5 . 7 8 9	. . . 3 4 5 6 7 . .	.	. . G I . . . . . K	—— oxyloba.
. . 2 3 . . . 7 8 9	. . . 3 4 5 . . . 9	50	F A G I . . . . . K	—— atrata.
0 . . 3 ? 5 6 7 8 9	. . 2 3 4 5 6 ? . .	.	F A G . . . . . . K	—— moschata.
. . . . 7 . .	. . . .	.	. A	—— ——, var. β hybrida.
. . . 3 ? . 6 7 . .	. . 2	.	F A G . . . . P . .	—— nana.
. . . . 4	. . . .	.	. . . I L C N . . .	Achillea Ageratum.
. . . 3 4 5 6 7 8 .	0 . . 3	.	F A . . L C N P . .	—— tomentosa.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Millefolium.
. 1 . . 4 5 6 7 . .	0 1 . 3 4 5 . 7 8 .	50	? . G I . . . . S K	—— lanata.
0 . 2 . 4 5 . 7 . .	. . . 3 . . . 7 8 .	.	F A G I L C N . . K	—— tanacetifolia.
. . . . 4 . . 7 8 .	0	.	F A ? I L C N . . K	—— nobilis.
. . . . . 5	. . . .	50	. . . I . . . P . .	—— odorata.
. . . . 4 ?	0 1	.	F A G I L C N P S K	Anthemis tinctoria.
. . . .	. . . .	.	F . . . . . ? . . .	—— ——, var. (A. discoidea).
. . . .	. . . .	.	. . . I L C N P . K	—— ——, var. (A. Triumfetti).
. . . .	0	.	? . . I L C N . . .	—— altissima.
0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— arvensis.
. . . . 4 5 . . 8 .	0 . . 3 4 5	.	F A G I L C N P S K	—— Cotula.
. . . . 4	. . . .	.	. . G . . C N P . K	—— montana.
0 1 2 3 4 5 . 7 8 .	0 1 . 3 4 5	.	F A G I L C N P S K	Matricaria Chamomilla.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Leucanthemum vulgare.
. . 2 3 4 5 6 . 8 9	0 1 . 3 4 5 6 7 . .	.	? A G I L C N ? . K	—— montanum.
. . . .	. . . .	.	F A G I L C N P . .	—— coronopifolium.
. . . .	. . . .	.	F . G , L C . P . .	—— ——, var. ceratophylloides.
0 . 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 . 9	50	F A G I . C . P . K	—— alpinum.
. . . .	. . . .	.	. . . . K	—— ——, var. cinereum.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Leucanthemum elegans (*Pollini*)	. . . .	. . . .	. . . .
—— corymbosum, *Gren. & Godr.*	1 2 3 4 5 . 7 8 9	. . 2 . . . 6 . . .	. . 2 . 4 5 6 7 8 9
—— Parthenium, *Gren. & Godr.*	1 2 . . . . . 8 9	. . . . . . 6 7 8 .	0 . . . . . . 7 8 .
—— Achilleæ (*Linn.*)	? ?	. . . .	. . . .
Tripleurospermum inodorum, *Sch. Bip.*	1 2 3 4 . . 7 8 9	0 . 2 . 4 . 6 . . .	. . . .
Pinardia coronaria, *Less.*?	1 2	. . . .	. . . . . 5 . . . .
Doronicum Pardalianches, *Linn.*	1 . 3 4 5 . . 8 9	 9	. . 2 . . . . 7 8 .
—— cordifolium, *Sternb.*	. . . .	. . . .	 9
—— austriacum, *Jacq.*	. 2	. . . . . . 6 . . .	. . . .
Aronicum Clusii, *Koch*	1 2 3 4 5 6 7 8 9	0 1 2 . . 5 6 7 8 .	0 1 . . 4 5 6 . 8 9
—— glaciale, *Reichb.*	1	. 1 . . . . 6 . 8 .	. . . . 4 5 . 7 8 .
—— scorpioides, *Koch*	1 2 3 4 5 . . 8 .	. 1 . . . 5 6 . . .	. . 2 . 4 5 6 7 8 .
Arnica montana, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Senecio vulgaris, *Linn.*	1 2 . . . . 7 8 9	0 1 2 . 4 5 6 7 8 9	. . 2 3 4 5 6 7 8 9
—— viscosus, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 . 4 5 6 . 8 9	0 1 2 3 4 5 . 7 8 9
—— sylvaticus, *Linn.*	1 2	. . . .	. . . . ? . . . . .
—— nebrodensis, *Linn.*	. . . .	. . . .	. . 2 3 4 5 6 7 8 9
—— squalidus, *Linn.*	1 2	. . . .	. . . .
—— abrotanifolius, *Linn.*	. . . .	. . . . . 5 6 . . .	. . 2 3 4 5 6 . 8 9
—— præaltus, *Bert.*	. . . .	. . . .	. . . .
—— erucifolius, *Linn.*	. 2 . 4 . 6 . . .	. . . .	. . . . 7 8 9
—— Jacobæa, *Linn.*	. . . 4 . 6 7 8 9	. 1 2 . 4 . 6 . 8 9	. . 2 . 4 . 6 7 8 .
—— aquaticus, *Huds.*	. . . .	. . . . . . 6 . . .	. . 2 . 4 5 6 . 8 .
—— ——, var. (S. erraticus, *Bert.*)	1 2 . 4 9	. . . . . . 6 . 8 9	0 1 . 3 4 . . 7 8 9
—— cordatus, *Koch*	. . . .	. . . . . . ? . . .	0 1 2 3 4 5 6 7 8 9
—— ——, var. (S. subalpinus, *Koch*).	. . . .	. . . .	. . . .
—— incanus, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (S. Persoonii, *De Not.*).	1 2 3 4	. . . .	. . . .
—— ——, var. (S. carniolicus, *Willd.*)	. . . . 8 .	. . . . 8 .	? . 2 . 4 5 . . 8 .
—— uniflorus, *All.*	. . . . 8 9	0 . 2 . . 5 6 7 8 9	. . . . 8 ?
—— Cacaliaster, *Lam.*	. . . .	. . . .	. . . .
—— nemorensis, *Linn.*	1 2 3 4 . 6 7 8 9	. . 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (S. Fuchsii, *Gmel.*)	1 2	. . . . . . 6 . . .	. . . . . . 6 . . 9
—— Doria, *Linn.*	1	. . . . . . 6 . 8 .	. . . .
—— paludosus, *Linn.*	. . . .	. . . .	. . 2 . ? . 6 . 8 .
—— Doronicum, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 . .	0 1 2 3 4 5 6 7 8 9
—— campestris, *DC. Prod.*	. . . . 8 .	. . . .	. . 2 . 4 . 6 7 . .
—— Balbisianus, *DC.*	1 . 3 . 5	. . . .	. . . .
—— brachychætus, *DC.*	. . . . 5	 9	. . 2 . 4 . 6 . 8 .
—— ——, var. (S. spathulæfolius, *DC.*)	. . . .	. . . .	. . . .
—— ——, var. (S. alpestris, *DC.*)	1 2	. . . .	. . . .
—— aurantiacus, *DC.*	1 2 3 4 5 . . 8 .	. . . . . . 6 . 8 .	. . 2 . 4 . . 7 . .
—— Cineraria, *DC.*	1 2	. . . .	. . . .
Calendula arvensis, *Linn.*	1 2	. . . .	 9
Echinops sphærocephalus, *Linn.*	1 . . . . 6 7 8 .	. . . .	. . . . . . 6 . . .
—— Ritro, *Linn.*	1 2 3 . . . . 8 .	. . . .	. . . .
Cirsium lanceolatum, *Scop.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— eriophorum, *Scop.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	. 1 2 . 4 5 6 7 8 9
—— palustre, *Scop.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— canum, *Bieb.*?	. 2 3	. . . .	. . . .
—— pannonicum, *Gaud.*	. . . .	. . . .	. . 2 . 4 . 6 7 8 .
—— carniolicum, *Scop.*?	. . . .	. . . .	 9
—— Erisithales, *Scop.*	1 2 3 4 . . 7 8 9	0 . . . . 5 6 7 8 9	. 1 2 . 4 5 6 7 8 9
—— Candolleanum, *Naeg.*	. . . .	. . . .	. . . . . . 6 . . .
—— spinosissimum, *Scop.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 . 9

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . . 4	. . . .	.	. . . I	Leucanthemum elegans.
0 1 2 3 4 5 . . 8 .	0 1 2 3 4 . . . 8 .	50	F A G I L C ? P . K	—— corymbosum.
. . . . . 5 . . 8 .	0 1 . 3 4 . . 7 . .	.	F . . . L C N P S K	—— Parthenium.
. . . .	. . . .	.	. . . . L C N . . .	—— Achilleæ.
. . . . 7 . .	. . . .	.	F ? ? I L . . P S K	Tripleurospermum inodorum.
. . . .	. . . 3	.	. A . . L C N . . .	Pinardia coronaria.
. . . .	. . . . 7 8 .	.	F A G I L C . P . K	Doronicum Pardalianches.
0 . . 3 4 . 6 . 8 9	. . 2 3 4 5	.	. . G ? L C N . . K	—— cordifolium.
. . . . 4 5 . . 8 9	0 1 2 3 . 5	50	. . G I L C . P . K	—— austriacum.
0 . 2 3 4 . 6 7 8 9	. . 2 3 4 5 . 7 . .	.	F A G I L . . . . K	Aronicum Clusii.
. . . 3 4 . . 7 . 9	. . . 3 9	.	. A G I . . . . . K	—— glaciale.
. . . 3 4 5 6 . 8 9	. . 2 3 4 . 6 7 . .	50	F A G I . . . P . K	—— scorpioides.
0 1 2 3 4 5 6 7 8 9	. 1 . 3 4 5 6 7 8 .	.	F A G I L . . P S K	Arnica montana.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 . 5 . 7 8 9	50	F A G I L C N P S K	Senecio vulgaris.
0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 . .	.	F A G I L C ? P S K	—— viscosus.
. . . . . 5 . . 8 .	. . . . . 5 . 7 . .	.	? A G I . C ? P S K	—— sylvaticus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 ? .	.	. . G I L C N . . K	—— nebrodensis.
. . . .	. . . .	.	F . . I L . N . . K	—— squalidus.
. . 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 8 9	50	. A G I . . . . . K	—— abrotanifolius.
. . . .	. . . . . 5	.	. . ?	—— præaltus.
. . . . 4	0 1 . . 4 . . 7 . .	.	F A G I L C N P S K	—— erucifolius.
. . 2 . 4 5 6 . . .	0 1 2 . 4 5 6 7 8 .	50	F A G I L C N P S K	—— Jacobæa.
. . . . . 5 . 7 . .	. . . . 4	.	F A G ? . . . P S K	—— aquaticus.
0 1 2 3 4 5 6 7 8 9	0 1 . 3 . 5 . 7 . .	50	F . . I L C N P S K	—— ——, var. (S. erraticus).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	.	F A G I . C N . . K	—— cordatus.
. . . . 8 .	. . . 3	50	. . G . . . . . . K	—— ——, var. (S. subalpinus).
. 1 . 3 . 5 6 7 8 9	. . . 3 4 5 . 7 . .	.	F A G ? ? C . . . ?	—— incanus.
. . . .	. . . .	.	. . . . L	—— ——, var. (S. Persoonii).
. . 2 3 . . 6 7 8 9	. . . 3 4 5 . 7 . 9	.	. A G I . . . . . K	—— ——, var. (S. carniolicus).
. . . .	. . . .	.	F A	—— uniflorus.
0 . 2 3 4 5 6 7 8 9	. 1 . 3 4 5 . 7 8 .	.	. . G I . . N . . .	—— Cacaliaster.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P S K	—— nemorensis
0 . 2 3 4 . 6 7 8 9	. . . 3 . . . 7 . .	.	F . G . L C . P . ?	—— ——, var. (S. Fuchsii).
. . . . 4	. . . . 7 . .	.	F . G . . . . . . K	—— Doria.
0 . . . 4 5 . 7 . .	0	.	F A . I . . . P S K	—— paludosus.
. 1 . 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . .	.	F A G I L C N P . K	—— Doronicum.
. . . 3	. . . .	.	. A G I L . . . S K	—— campestris.
. . . .	. . . .	.	. . . .	—— Balbisianus.
0 1 2 3 4 5 . 7 8 .	0 1 2 3 4 5 . 7 8 .	.	. A G I L C N P . ?	—— brachychætus.
. . . . 4 5 . . 8 .	. . . .	.	F A G I . . . P . K	—— ——, var. (S. spathulæfolius).
. . 2 3 4 5 . 7 8 9	. . . . 8 9	50	. . G I . . . . . K	—— ——, var. (S. alpestris).
. . . .	. . . .	.	F A G I L . . . S K	—— aurantiacus.
. . . .	. . . .	.	. . . I L C N . . .	—— Cineraria.
. 1 . . . ?	0	50	F . ? I L C N P . ?	Calendula arvensis.
. . 2 . 4 5 . 7 . .	0 . . 3	50	F A G I L C . P . K	Echinops sphærocephalus.
. . . .	. . . .	50	F . . I L . . P . K	—— Ritro.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P S K	Cirsium lanceolatum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P . K	—— eriophorum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	.	F A G I L C N P S K	—— palustre.
. . . .	0 . . 3	.	. . G . . . . . S K	—— canum.
. 1 2 3 4 5 6 . 8 .	0 1 . 3 . 5 . 7 . 9	50	. . G I . . . . . K	—— pannonicum.
. . . . 4	. 1	.	. . G I . . . P . .	—— carniolicum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	. A G I L C N . . K	—— Erisithales.
. . . .	. . . .	.	. . . .	—— Candolleanum.
0 . . 3 . 5 6 7 8 9	. . 2 3 4 5 . 7 . .	50	F A G I L . . P . .	—— spinosissimum.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Cirsium flavescens, *Koch* (hybr.)	. . . .	. . . .	. . . .
—— Dollinerii, *Sch. Bip.* (hybr.)	. . . .	. . . .	. . . .
—— oleraceum, *Scop.*	. . . 4 9	. . . . 4 5 6 7 8 .	. 1 2 3 4 5 6 7 8 9
—— purpureum, *All.*	1 . 3 4 5 . . 8 .	. . . .	. ? . . . .
—— rivulare, *Link*	1 . 3 . 5 6 7 . .	. . . 3	. . . . 7 8 .
—— monspessulanum, *All.*	1 2 . 4 . 6 7 . .	. . . .	. . . .
—— heterophyllum, *All.*	. . 3 . . . . 8 .	. . . . . 5 6 . . 9	. . 2 . 4 . . . 8 .
—— ambiguum, *All.* (hybr. ?)	. . . . 8 .	. . . .	. . . .
—— bulbosum, *DC.*	1 2 . . . . 7 . 9	. . . . 4	. . . . . . 6 . . .
—— acaule, *All.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .
—— ferox, *DC.*	. 2	. . . .	. . . . . ? . . . .
—— ——, var. Morisianum, *Reichb.*	. 2	. . . .	. . . .
—— arvense, *Scop.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Carduus pycnocephalus, *Jacq.*	1 2	. . . .	. . . . . . 6 . . .
—— acanthoides, *Linn.* ?	. . 3 4	. 1 . . 4 . 6 . 8 .	. . . .
—— tenuiflorus, *Curt.*	1 2	. . . .	. . . .
—— crispus, *Linn.*	. . . . 8 .	. . . .	. . . .
—— ——, var. (C. multiflorus, *Gaud.*)	. . . .	. . . .	. . . . 4 . . 7 . .
—— Sanctæ-Balmæ, *Lois.*	1 2 3	. . . .	. . . .
—— arctioides, *Willd.*	. . . .	. . . .	. . . .
—— Personata, *Jacq.*	1 2 . . . 6 7 . .	0 . . . 4 . 6 . 8 9	. 1 2 3 4 . . . 8 .
—— defloratus, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (C. Barrelieri, *Bert.*)	. . . .	 9	. . . . . . 6 . . .
—— ——, var. (C. spinulosus, *Bert.*) ?	1 . 3 . . . . 8 .	. . . .	. . . .
—— nutans, *Linn.*	1 . 3 4 5 . 7 8 9	0 1 2 3 4 5 6 . . .	. . 2 . 4 5 6 7 8 9
—— ——, var. C. montosus, *Pollini*) ?	1 . 3	. . . .	. . 2 . 4 . 6 . . 9
—— ——, var. (C. platylepis, *Saut.*)	. . . .	. . . .	. . . .
Onopordon Acanthium, *Linn.*	1 2 3 4 5 6 . 8 9	. 1 2 3 4 5 6 . . 9	. 1 2 . 4 5 6 7 8 .
Carduncellus monspeliensium, *Linn.*	1	. . . .	. . . .
Lappa major, *Gærtn.*	1 2 3 4 5 . 7 8 .	. 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 . 7 8 9
—— minor, *DC.*	. . . . . . 7 . .	0 1 2 . 4 5 6 . 8 .	0 1 . . 4 5 . 7 8 .
—— tomentosa, *Lam.*	1 2 3 . . . 7 . .	. . . .	. . . . 4 . . . 8 .
Carlina acaulis, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— acanthifolia, *All.*	1 2 3 4 5 . 7 8 .	. . . .	. . . .
—— corymbosa, *Linn.*	. 2	. . . .	. . . .
—— vulgaris, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Stæhelina dubia, *Linn.*	1	. . . .	. . . . 8 .
Berardia subacaulis, *Vill.*	1 . . 4 . . 7 . .	. . . . ? .	. . . .
Saussurea alpina, *DC.*	. . . . 5 ? . 8 .	. 1 2 . . 5 6 7 8 .	. . . . 4 5 . . 8 .
—— discolor, *DC.*	. . . .	. . . . 8 .	. 1 2 3 4 5 6 7 8 .
—— pygmæa, *Spreng.*	. . . .	. . . .	. . . .
Serratula tinctoria, *Linn.*	1 2 . . . . . 8 9	. . . . 4 . 6 . . 9	0 . 2 . . . 6 7 8 9
—— nudicaulis, *Linn.*	1 2	. . . .	. . . .
—— Rhaponticum, *DC.*	1 2 3 . . 6 7 . 9	. 1 2 . . 5 6 7 . .	. . 2 . 4 . 6 7 8 .
Leuzea conifera, *DC.*	1 2 . . . . . 8 .	. . . .	. . . .
Jurinea mollis, *Reichb.*	. . . .	. . . .	. . . .
Kentrophyllum lanatum, *DC.*	1 2 . 4 . . 7 8 .	. . . . 4	. . . . 7 8 .
Centaurea alpina, *Linn.*	. . . .	. . . . 8 .	. . . .
—— alba, *Linn.*	1 . . . . . 7 8 .	. . . . 4 . . . 8 .	0 . 2 . . . 6 . 8 .
—— amara, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9
—— Jacea, *Linn.* ?	1 2 . . . . . 8 .	. . . . 4 . ? . . .	. . . . . . 6 . . .
—— nigra, *Linn.*	. 2 ?	. . . .	. . . .
—— nigrescens, *Willd.*	. . . 4 . . 7 8 9	0 1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 .
—— ——, var. (C. transalpina, *Schl.*)	1 2 3 . 5 6 . 8 .	. . . . 4 5 6 7 8 9	0 1 2 . 4 . 6 . 8 9

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. 1 2 . . . 6 7 8 9	. . . .	.	. . . .	Cirsium flavescens (hybr.).
. 1	. . . .	.	. . . .	—— Dollinerii (hybr.).
0 1 2 3 4 5 6 . 8 .	. 1 2 3 4 5 6 7 8 9	.	F A G I ? C N P S K	—— oleraceum.
. 1 2 3	. . . .	.	F ?	—— purpureum.
. 1 . 3 4 5 . 7 8 9	0 . . 3	.	? A G I L . . P . K	—— rivulare.
. 1 . . ?	. . . 3	.	F . . . L C N P . K	—— monspessulanum.
. . 2 3 . . 6 7 8 9	. . . 3 4 5	.	F A G ? . . . P S K	—— heterophyllum.
. . . . 7 8 .	. . . .	.	?	—— ambiguum (hybr.).
. . . . 4	? . . 3 4	.	F A . . L . . . . K	—— bulbosum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— acaule.
. . . .	. . . .	.	F . . . . C N P . .	—— ferox.
. . . .	. . . .	.	. . . .	—— ——, var. Morisianum.
. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	.	F A G I L C N P S K	—— arvense.
. . . . 4	0 1	.	. . . I L C N . . .	Carduus pycnocephalus.
. . . . . 5 6 7 . .	. . . . 7 . .	.	? A G I . . . P S K	—— acanthoides.
. . . .	. . . .	.	. A . . . . . P . .	—— tenuiflorus.
. . . . ? ?	. ? . 3 . . 6 . . .	.	F A ? ? . . . . S K	—— crispus.
0 . . 3 4	. . . .	.	. A . . L	—— ——, var. (C. multiflorus).
. . . .	. . . .	.	F . . . L C	—— Sanctæ-Balmæ.
0 1 2	. . . 3 4 5 . 7 . 9	.	. A G I L . . . . K	—— arcticides.
0 . 2 3 . . 6 7 8 9	. . 2 3 4 5 . 7 . .	.	F A G I ? C N . . K	—— Personata.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L . . P . K	—— defloratus.
. . . .	. . 2	.	. . . . L C	—— ——, var. (C. Barrelieri).
. . . .	. . 2 3 4	.	. . . . L	—— ——, var. (C. spinulosus).
0 1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P S K	—— nutans.
. . . . 4 5 6 . . 9	0 1 2 3 4	.	F . . . L C N P . .	—— ——, var. (C. montosus).
. . . 3 . . . . 8 .	. . . 3 4	.	. . G	—— ——, var. (C. platylepis).
. 1 2 3 4 5 6 7 8 9	0 1 . 3 . 5	.	F A G I L C N P S K	Onopordon Acanthium.
. . . .	. . . .	.	F	Carduncellus monspeliensium.
0 1 2 3 4 5 6 7 8 9	. 1 . 3 . 5	.	F A G I ? C N P S K	Lappa major.
. . 2 . 4 5 . . 8 9	0 1 . 3 4 5 . 7 . .	.	F A G I L C N P S K	—— minor.
. . . . 4 5 . . 8 .	. . . 3 . 5	.	F A G I L ? ? P S K	—— tomentosa.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P . K	Carlina acaulis.
. . . .	. . . . 7 . 9	50	F . . I L C N P . .	—— acanthifolia.
. . . .	. . . .	.	. . . I L C N . . .	—— corymbosa.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P S K	—— vulgaris.
. . . .	. . . .	.	F . . I L C N . . .	Stæhelina dubia.
. . . .	. . . .	.	F	Berardia subacaulis.
. . . 3 . . . 7 8 9	. . . . 4 5	.	F A G I . . . P S K	Saussurea alpina.
. . 2 3 . 5 . . 8 9	. . . 3 4 . . 7 8 .	.	F A G I . . . . . K	—— discolor.
. . . .	. . . . 7 . 9	.	. . G I . . . . . K	—— pygmæa.
0 1 2 3 4 5	0 1 . 3 4 5 6 7 . .	.	F A G I L C N P S .	Serratula tinctoria.
. . . .	. . . .	.	F A . . . . N P . .	—— nudicaulis.
0 1 2 3 4 5	. 1 2 3 4 . 6 . 8 .	50	F A G I	—— Rhaponticum.
. . . .	. . . .	.	. . . . L . . P . .	Leuzea conifera.
. . . .	. 1 . . 4	.	. . . I . . N . . K	Jurinea mollis.
0 . 2 . 4 5 6 . . .	0 1 . 3	50	F A . I L C N P . K	Kentrophyllum lanatum.
. . . .	. . . 3	.	. . . .	Centaurea alpina.
. . . . 4	0	.	. . . I L C N . . .	—— alba.
. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . .	.	F A . I L C N P . K	—— amara.
. . . . 4 . . 7 8 .	. . . . 7 . .	.	F A G I . . . ? S K	—— Jacea.
. . . .	. . . .	.	F A . . . . . P S K	—— nigra.
. . 2 . 4 5 6 7 8 9	0 1 . 3 4	.	F A G I L C N ? . K	—— nigrescens.
. 1 2 3 . 5 6 7 8 9	. 1 2 3 4 5 . 7 . 9	.	. . . . L	—— ——, var. (C. transalpina).

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Centaurea austriaca, *Linn.*	. . . . ?	. . . .	. . 2 . . . 6 7 . 9
—— ——, var. (C. flosculosa, *Balb.*)	1 2	. . . . . . ? . . ?	. . . .
—— nervosa, *Linn.*	1 . . 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 9	0 1 . . 4 . 6 . 8 9
—— ——, var. (C. Ferdinandi, *Gren.*)?	. . . . . 6 . . .	. . . .	. . . .
—— uniflora, *Linn.*	1 2 3 4 5 6 7 8 9	0 . . . . ? .	? . . . .
—— procumbens, *Balb.*	1 2	. . . .	. . . .
—— montana, *Linn.*	1 2 3 4 5 . 7 8 9	0 . 2 . . . 6 7 8 9	. . 2 . 4 . 6 7 8 9
—— ——, var. (C. axillaris, *Willd.*)	1 2 . . . 6 . 8 .	. . . .	. . 2 . . . . . 8 .
—— Cyanus, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Scabiosa, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Kotschyana, *Heuff.*	. . . . 5 6 . 8 .	. . . .	. . . .
—— sordida, *Willd.*	. . . .	. . . .	. . . .
—— paniculata, *Linn.*	1 2 3 4 . 6 7 8 9	. . 2 . 4 . 6 7 8 .	. . . . 4 . . 7 8 9
—— ——, var. (C. leucophæa, *Jord.*)	1 2 3	. . . .	. . . .
—— maculosa, *Linn.*	1	. . . . . . 6 . . .	. . 2 . . . . . 8 .
—— cinerea, *Lam.*?	1	. . . .	. . . .
—— collina, *Linn.*?	1	. . . . 4	. . . .
—— rupestris, *Linn.*	. . . .	. . . .	. . . .
—— cristata, *Bartl.*	. . . .	. . . .	. . . .
—— hybrida, *All.* (hybr.?)	. . . .	. . . . 4	. . . .
—— solstitialis, *Linn.*	. . . . 8 .	. . . . . . 6 . . 9	. . . . 7 8 .
—— Calcitrapa, *Linn.*	1 2 3 4 . . . 8 9	. . . . 4	. . 2 . 4 . 6 7 8 .
—— aspera, *Linn.*	1 2	. . . .	. . . .
Crupina vulgaris, *Pers.*	1 2 3 4 . . 7 8 .	. . . . 4	. . . .
Xeranthemum radiatum, *Lam.*	1 . . . . . 7 8 .	. . . . 4	. . . .
—— inapertum, *Willd.*	. . . .	. . . .	. . 2 9
—— cylindraceum, *Sm.*	1 2 . . . . 7 8 .	. . 3 4	. . . . 8 .
Catananche cœrulea, *Linn.*	1 2	. . . .	. . . .
—— lutea, *Linn.*	. 2	. . . .	. . . .
Lapsana communis, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Aposeris fœtida, *Less.*	1	. . . .	. . 2 . 4 . 6 7 8 9
Arnoseris pusilla, *Gærtn.*	. . . .	. . . . 4	. . 2 . . . .
Rhagadiolus stellatus, *Gærtn.*	? ?	. . . .	. . . . 8 .
Hyoseris radiata, *Linn.*	. 2	. . . .	. . . .
Cichorium Intybus, *Linn.*	1 2 3 4 5 . 7 8 9	0 . . . 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9
Thrincia hirta, *Roth*	1 2 . . . . . 8 .	. . . . . . 6 . . .	. . . . . . 6 7 8 .
—— tuberosa, *DC.*	1 2	. . . .	. . . . 7 . .
Leontodon autumnalis, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. pratensis, *Koch*	. . . . . . 7 . .	. . 2 . . . . . 8 .	. . . . 7 . .
—— Taraxaci, *Lois.*	1 . . . . . 7 8 .	0 1 2 . . 5 ? . . .	. . . 3 4 5 . . 8 .
—— pyrenaicus, *Gouan*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— —— var. aurantiacus, *Koch*	. . . .	. . . .	. . ? . ? . ? . . .
—— hispidus, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (L. hastilis, *Linn.*)	1 2 . 4 5 . 7 8 9	0 1 2 . 4 . 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— ——, var. hyoseroides, *Koch*	. . . 4 . . 7 . .	. . 2	. . . . . 5 6 . . .
—— ——, var. (L. Brumati, *Reichb.*)	. . . .	. . . .	. . . .
—— tenuiflorus, *DC.*	. . . .	. . . .	. . 2 . . . 6 . . .
—— incanus, *Schrank*	. . . .	. . . .	. . . . . 5 . 7 8 9
—— Berinii, *Roth*	. . . .	. . . .	. . . .
—— crispus, *Vill.*	1 2 . 4 . . 7 8 .	. . . . 4 . ? ? . .	. . . . 7 8 .
—— Villarsii, *Lois.*	1 2 . . . . 7 . .	. . . .	. . . .
Picris hieracioides, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (P. stricta, *Jord.*)	. 2	. . . . 8 .	. . . .
—— pauciflora, *Willd.*	1 2	. . . .	. . . .
Tragopogon major, *Jacq.*	. 2 . . . . . 8 .	. . . .	. . . . 4 . . . 8 .
—— pratensis, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. tortilis, *Koch*?	. . . .	. . . .	. . . . 8 .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
0 1 2 . . . . 7 8 .	. . . . 7 . .	.	. A . . ? C N . S K	Centaurea austriaca.
. . . .	. . . .	.	. . . .	—— ——, var. (C. floscu-losa).
. 1 2 3 4 5 6 . 8 9	0 1 . 3 4 5 6 7 . .	50	F A G I L . . . . K	—— nervosa.
. . . .	. . . . 7 . .	.	F	—— ——, var. (C. Ferdi-nandi).
. . . .	. . . .	.	F . ?	—— uniflora.
. . . .	. . . .	.	F	—— procumbens.
0 1 2 3 4 5 6 . . 9	0 1 2 3 4 5 . 7 8 9	.	F A G I L C N P . K	—— montana.
. 1 2 3 4 5 . . 8 9	. . . 3 4 5 6 7 . .	50	F . G I L . . . . K	—— ——, var. (C. axillaris).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Cyanus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P S K	—— Scabiosa.
. . . . 7 . .	 9	.	F A G . . . . . . K	—— Kotschyana.
. . 2 . . 5	 9	50	. . ? I	—— sordida.
. 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 . 7 . .	.	F A ? I L C ? P . K	—— paniculata.
. . . .	. . . .	.	F . . . . . . P . .	—— ——, var. (C. leuco-phæa).
. . . 3 . 5 . 7 8 .	. . . 3	.	F . . . . K	—— maculosa.
. . . .	. . . .	.	. . . .	—— cinerea.
. . . .	. . . .	.	. . . ? L . . ? . .	—— collina.
. . . .	. . . 3 . . . 7 . 9	50	. . . I . C N . . .	—— rupestris.
. . . .	. . . 3	.	. . . I	—— cristata.
. . . .	0	.	. . . .	—— hybrida (hybr. ?).
. . . . 4	0 1 . 3	.	F . . I L C N P . K	—— solstitialis.
. 1 . . 4	0 1 . 3	.	F A . I L C N P . K	—— Calcitrapa.
. . . .	. . . .	.	F . . . L	—— aspera.
. . . . 4	0	.	F . . I L C N . . .	Crupina vulgaris.
. . . .	. . . 3	.	. . . . . C . . . ?	Xeranthemum radiatum.
. . . . 4	0 1 . 3	.	F A . I L C N P . .	—— inapertum.
. . . . 4	. . . 3	.	. . . I L C N . . K	—— cylindraceum.
. . . .	. . . .	.	F . . . L C ? P . .	Catananche cœrulea.
. . . .	. . . .	.	. . . . . . N . . .	—— lutea.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 .	50	F A G I L C N P S K	Lapsana communis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I . C . ? . K	Aposeris fœtida.
. . . .	. . . .	.	F A G I . C . . S K	Arnoseris pusilla.
. 1 . . 4	0	.	. . . . L C N . . .	Rhagadiolus stellatus.
. . . .	. . . .	.	. . . I L C N . . .	Hyoseris radiata.
0 1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P S K	Cichorium Intybus.
. . . .	. . . 3 . . . 7 . .	.	. ? G I L C N P . K	Thrincia hirta.
. . . . ?	0 . . 3	.	? . . I L C N . . .	—— tuberosa.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	.	F A G I L C N P S K	Leontodon autumnalis.
. . . . . . 6 . 8 9	. . 2 3	.	F . G . . . . . S K	—— ——, var. pratensis.
. . . . ? . 6 7 8 9	. . . . 4 5	.	F A G ? . . . ? . K	—— Taraxaci.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . .	50	F A G I L C N P S K	—— pyrenaicus.
. . . ? ? . . . 8 .	. . . . 4 5 . 7 . .	.	. . G I L . N . . K	—— ——, var. aurantiacus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— hispidus.
0 1 2 3 4 5 . . 8 9	0 1 . 3 4 5 . 7 . 9	50	F A G I L C N P . K	—— ——, var. (L. hastilis).
. . . 3 . 5 . 7 8 9	. . . 3 4 5 6 7 . 9	.	? . G I	—— ——, var. hyoseroides.
. . . .	. . . . 7 8 .	50	. . . I	—— ——, var. (L. Brumati).
. 1	?	.	. . . .	—— tenuiflorus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	. A G I . . . . . K	—— incanus.
. . . .	. . . . 4 5 . 7 8 9	50	. . . .	—— Berinii.
0 1 2 . 4 5	0 1 . 3 . . . 7 . .	50	F . . I L . N ? . .	—— crispus.
. . . .	. . . .	.	F . . . L C N P . .	—— Villarsii.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P S K	Pieris hieracioides.
. . . .	. . . .	.	F	—— ——, var. (P. stricta).
. . . .	. . . 3	.	. . . I . . . ? . .	—— pauciflora.
. . 2 . 4 5 . 7 8 9	. . . 3	.	F A G I L C N . . K	Tragopogon major.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— pratensis.
. . . .	. . . 3	.	. . . .	—— ——, var. tortilis.

	0 1 2 3 4 5 6 7 8 9	1 0 1 2 3 4 5 6 7 8 9	2 0 1 2 3 4 5 6 7 8 9
Tragopogon pratensis, var. (T. orientalis. *Linn.*).	1 2	. . . .	. . . .
—— crocifolius, *Linn.*	. 2 . . . 6 7 8 .	. . . 3	. . . .
Scorzonera austriaca, *Willd.*	. . . . 8 9	. . . . . . 6 . . .	. . . . 4 . 6 7 8 .
—— humilis, *Linn.*, non *DC.*	. . . . . 6 . 8 .	 9	. . 2 . 4 . 6 . . .
—— ——, var. (S. tenuifolia, *DC. Prod.*).	. 2 . . . . . 8 .	. . . .	. . . .
—— aristata, *Ram.*	. . . .	. . . .	. . . .
—— hirsuta, *Linn.*	. 2	. . . .	. . . .
—— hispanica, *Linn.*	1 2 3 . . 6 . . .	. . . .	. . . .
—— ——, var. (S. glastifolia, *Willd.*)	. 2 . . . . . 8 .	. . . .	. . . .
—— purpurea, *Linn.*	. . . .	. . . .	. . . .
—— ——, var. (S. rosea, *Waldst. & Kit.*)	. . . .	. . . .	 9
—— villosa, *Scop.*	. . . .	. . . .	. . . .
Podospermum laciniatum, *DC.*	1 2 3 4 . . 7 8 .	. . . 3 4	. . . .
Hypochæris glabra, *Linn.*	. . . . ?	. . . . ? . . 9	. . 2 . . . . 7 8 .
—— radicata, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— maculata, *Linn.*	1 2 3 4 5 . 7 8 9	. 1 . . 4 . 6 . . 9	. . . . 4 5 6 . 8 9
—— uniflora, *Vill.*	. 2 3 4 5 6 . 8 9	. 1 2 3 4 5 6 7 8 .	0 . 2 3 4 5 . 7 8 .
—— Facchiniana, *Andr.*	. . . .	. . . .	 9
Taraxacum officinale, *Wigg.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (T. lævigatum, *DC.*)	. . . . 5 . . 8 9	. . 2 3 . . . . 8 .	0 . . . 4 5 . . . .
—— ——, var. (T. palustre, *DC.*)	1	. . . . 8 9	. . . . 4 . . 7 8 9
Chondrilla juncea, *Linn.*	1 2 3 4 . . 7 8 9	. . . . 4 5 6 . 8 9	0 1 2 3 4 . 6 7 8 .
—— prenanthoides, *Vill.*	. . . .	. . . .	. . . .
Willemetia apargioides, *Less.*	. . . .	. . . .	. . . . . 5 . . . .
Prenanthes purpurea, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 . 4 5 6 7 8 9	0 1 2 . 4 . 6 7 8 9
—— ——, var. (P. tenuifolia, *Linn.*).	. . . . 8 9	. . . . . . 6 . . 9	. 1 . . . . . . ? .
Lactuca virosa, *Linn.*	1 2 3 . 5 . 7 8 9	0 . 2 3 4	. . . . . . 6 . 8 .
—— Scariola, *Linn.*	1 2 . . 5 . . 8 .	0 . 2 3 4 5 6 . . 9	. . . . 4 5 . 7 8 .
—— ——, var. (L. augustana, *All.*)	. . . . 8 .	. 1 . 3 4	. . . .
—— saligna, *Linn.*	1 2 . . . . . 8 9	0 . . . 4 . 6 . . 9	. . . . 7 8 .
—— viminea, *Sch. Bip.*	1 2 . . . 6 . 8 .	. . . 3 4	. . . .
—— quercina, *Linn.*	. 2 3	. . . .	. . . .
—— muralis, *Fres.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— perennis, *Linn.*	1 2 3 4 . . 7 8 .	0 1 2 3 4 5 6 . 8 9	. . 2 . 4 5 6 . 8 9
—— tenerrima, *Pourr.*	1 . . . . . . 8 .	. . . .	. . . .
Sonchus oleraceus, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— asper, *Vill.*	1 2	. . . . . . 6 . . .	. 1 . . 4 5 . 7 8 .
—— arvensis, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 . 9	. . . . 4 5 . 7 8 .
—— palustris, *Linn.*	. . . .	. . . .	. . . .
Mulgedium alpinum, *Less.*	1 . 3 4 5 . . 8 .	. . 2 . . 5 6 7 8 9	0 1 2 . 4 5 . . 8 .
Picridium vulgare, *Desf.*	1 2	. . . .	. . . . ? . . . . .
Endoptera aspera, *DC.*	. . . .	. . . .	. . . .
Pterotheca nemausensis, *Cass.*	1	. . . .	. . . .
Barkhausia alpina, *DC.* ?	. . . .	 9	. . . . ? . . . ? 9
—— albida, *Cass.*	1 2 3 4 5 . 7 8 .	. . . .	. . . .
—— fœtida, *DC.*	1 2 3 4 5 6 7 8 9	0 . . 3 4 . 6 . . .	. . 2 . 4 . 6 7 8 9
—— rubra, *Moench* ?	1	. . . .	. . . .
—— taraxacifolia, *DC.*	1 2	. . . .	. . . . 8 .
—— ——, var. (B. vesicaria, *Spreng.*)	. . . .	. . . .	. . . . 8 .
—— setosa, *DC.*	1 . 3 4 5 . 7 8 .	0 . . . . . . 7 8 .	0 . 2 . 4 . 6 7 8 9
Crepis præmorsa, *Tausch*	1 2 . . . 6 . 8 .	. . . .	. . 2 . . 5 6 7 . .
—— incarnata, *Tausch*	. . . .	. . . .	. . . . . . 6 7 . .
—— ——, var. (C. Frœlichiana, *DC.*)	. . . .	. . . .	. . 2 . . . 6 7 . .

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . . . 5	. . . .	.	. A G I . . . . . K	Tragopogon pratensis, var. (T. orientalis).
. . . .	. . . .	.	F . . I L C N . . .	—— crocifolius.
. 1 2 . 4 5 . 7 8 .	0 . . 3 4 . . 7 . .	.	F A G I L . . . . K	Scorzonera austriaca.
. . . . 4 5 . 7 8 9	0 . 2 3 4 5 . 7 . .	50	F A G I L . N P S K	—— humilis.
. . . . 4	. . . .	.	. . . .	—— ——, var. (S. tenuifolia).
. . . . 4 5 . 7 8 9	. . 2 3 4	.	. . G I L . . P . .	—— aristata.
. . . .	. . . .	.	F . . I L . N . . .	—— hirsuta.
. . . .	. . . .	.	F ? . I . C . P . K	—— hispanica.
. . . .	. . . .	.	F A . . L C N . . .	—— ——, var. (S. glastifolia).
0 1 . 3 4 5	. 1 . 3 4 . . 7 . .	.	. . . I . C N . . K	—— purpurea.
. . . . 4 5	0 . . 3 4 5 . 7 8 9	50	. . . I . . . . . K	—— ——, var. (S. rosea).
. . . .	. . . . ? . . 7 . 9	50	. . . I . . . . . K	—— villosa.
. . . .	. . . .	.	F A . I L C N P . K	Podospermum laciniatum.
. . . .	. . . .	.	? A ? I L C N ? S K	Hypochæris glabra.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5	50	F A G I L C N P S K	—— radicata.
0 1 . . 4 . . 7 8 9	0 . . 3 . . . 7 8 .	.	F A G I L C ? P S K	—— maculata.
. . . 3 ? 5 6 7 8 9	. 1 2 3 4 5 . 7 . .	.	F A G I L . . . . K	—— uniflora.
0 . 2 3	. . . .	.	. . . .	—— Facchiniana.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Taraxacum officinale.
0 1 2 . 4 5 6 . 8 9	. . . 3 4 9	50	F A G . L C N P . K	—— ——, var. (T. lævigatum).
. . . . . . 6 . 8 9	. . . 3 4	.	F A G I L C ? P S K	—— ——, var. (T. palustre).
0 1 2 . 4 5 6 7 8 .	0 1 . 3 . 5 6 7 8 .	50	F A ? I L C N P . K	Chondrilla juncea.
0 . . 3	. . . 3 4 5 6 7 8 9	50	. A G I	—— prenanthoides.
. . . . ? . . 7 8 9	. . . .	.	. . G . . . . . . ?	Willemetia apargioides.
0 . 2 3 4 5 6 7 8 9	. . 2 3 4 5 . 7 . .	.	F A G I L C N P . K	Prenanthes purpurea.
0 . . . 4 5 . . 8 .	. . . .	.	F . G	—— ——, var. (P. tenuifolia).
. . . . 4 5 6 . 8 .	?	.	F A G I L C N P . K	Lactuca virosa.
. . 2 . 4 5 6 7 . .	0 1 . 3	50	F A G I L C N P . K	—— Scariola.
. . . .	. . . .	.	F A	—— ——, var. (L. augustana).
. . . . 4 5 . . 8 .	. . . 3 . . . 7 . .	.	F A . I L C N P . K	—— saligna.
. . . . 4	. . . .	.	F A . I L C N P . K	—— viminea.
. . . .	. . . .	.	. . . I . . . . . K	—— quercina.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P S K	—— muralis.
0 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 . 7 8 .	50	F A ? I L C N P . K	—— perennis.
. . . .	. . . .	.	. . . . P . .	—— tenerrima.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C ? P S K	Sonchus oleraceus.
. 1 . 3 4 5 . 7 8 .	0 1 . 3 . . . 7 8 .	.	F A G I L C N P S K	—— asper.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P S K	—— arvensis.
. . . .	. . . . 7 . .	.	. ? ? ? . . . P ? ?	—— palustris.
0 1 2 3 4 5 . 7 8 9	. . . 3 4 5	.	F A G I L . . P S K	Mulgedium alpinum.
. . . .	. . . .	.	F . . I L C N P . .	Picridium vulgare.
. . . .	. . . . 7 . .	.	. . . . . . N . . .	Endoptera aspera.
. . . .	. . . .	.	? . . . L	Pterotheca nemausensis.
. . . .	. . . .	.	. . . . ?	Barkhausia alpina.
. . . .	. . . .	.	F . . . L . . P . .	—— albida.
0 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 6 7 . 9	.	F A G I L C N P . K	—— fœtida.
. . . .	. . . .	.	. . . I . . N . . .	—— rubra.
. . . .	. . . .	.	F A G I L . . P ? K	—— taraxacifolia.
. . . .	. . . . ? .	.	. . . I L C N . . .	—— ——, var. (B. vesicaria).
0 1 2 3 4 5 6 . . .	0 1 2 3 . 5 . 7 . .	50	? A G I L C N P . K	—— setosa.
. . . 3 4 5 6 . . .	0 1 . 3	.	. A G I . . . . S K	Crepis præmorsa.
0 . 2 . 4 5 6 . 8 9	. 1 . 3 4 5 . 7 8 9	50	. . G I	—— incarnata.
0 1 . . . 5 6 . 8 9	0 1 2 3 4	.	. . G I	—— ——, var. (C. Frœlichiana).

	0 1 2 3 4 5 6 7 8 9	1 0 1 2 3 4 5 6 7 8 9	2 0 1 2 3 4 5 6 7 8 9
Crepis aurea, *Cass.*	1 2 . . . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 . 8 .
—— alpestris, *Tausch*	. . . . 5	. . . .	. . 2 . . 5 . . 8 .
—— ——, var. (Barkhausia mucronata, *Bert.*).	. . . .	. . . .	. . . .
—— chondrilloides, *Jacq.*	. . . .	. . . .	. . . .
—— biennis, *Linn.*	. . . . 8 9	. 1 2 . 4 . 6 . . .	. . 2 . 4 5 6 7 8 .
—— nicæensis, *Balb.*	. 2	. . . .	. . . .
—— tectorum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— virens, *Vill.*	1 . . . 5 . . 8 .	. . 2 . . . ? . . 9	. . . . 7 8 .
—— neglecta, *Linn.*	. . . . . 6 . . .	. . . . 4 . ? . . .	. . . . 8 .
—— pulchra, *Linn.*	1 2 . . . . 7 . .	. . . . 4 . 6 . . .	. . . . 8 .
—— Jacquini, *Tausch*	. . . .	. . . .	. . . . 4 5 6 . 8 9
—— paludosa, *Moench*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 2 . 4 5 6 . 8 .
—— succisæfolia, *Tausch*	1	. . . .	. . . . ? . . 7 . .
—— pygmæa, *Linn.*	1 . . . . . 7 . .	. . ?	. . . . . 5 . . 8 .
—— blattarioides, *Vill.*	1 2 . . 5 . 7 8 9	. 1 2 . 4 5 6 . 8 .	0 1 2 3 4 . 6 . 8 .
—— grandiflora, *Tausch*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .
Soyeria montana, *Monn.*	1 . . . . 6 7 8 .	. . . .	. . . .
—— hyoseridifolia, *Koch*	. . . .	. . . .	. . . .
Hieracium Pilosella, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (H. Peleterianum, *Mérat*).	. . 3 . . . . 8 .	. 1 2	. . . . 4 . . 7 8 .
—— ——, var. (H. pilosellæforme, *Hoppe*).	. . . . 8 .	. . . .	. . . . . 5 . 7 8 .
—— bifurcum, *Bieb.*	. . 3	. . . . 8 .	0 . 2 . . . . . 8 .
—— ——, var. (H. Hausmanni, *Reichb.*).	. . . .	. . . .	. . . .
—— furcatum, *Hoppe*	. . . . 8 .	. . . .	. . . 3 4 5 . 7 8 .
—— angustifolium, *Hoppe*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 . 7 8 .
—— Auricula, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— florentinum, *All.*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (H. Bauhini, *Bess.*)	. . . .	. . . .	. . 2 . . . .
—— pratense, *Tausch*	. . ? . . . 7 8 .	. . 2 . . . . . 8 .	. . . . ? 8 .
—— aurantiacum, *Linn.*	1 2 3 . . . 7 8 .	. . . . 8 9	0 . . 3 4 5 . . 8 9
—— sabinum, *Sebast. & Mauri*	1 2 3 . 5 . 7 8 .	. 1 2 ?	. . 2 . . . .
—— ——, var. (H. Laggerii, *Sch. Bip.*)	. . . .	. . . 3	. . . .
—— staticifolium, *Vill.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— porrifolium, *Linn.*	. . . . . . ? . .	. . . . . . 6 . . .	. . 2 . 4 5 6 7 . 9
—— ——, var. dentatum, *Froel.*	. . . .	. . . .	. . . .
—— politum, *Fr.*	. . . .	. . . .	. . . .
—— glaucum, *All.*	. . 3 4 . . 7 . .	. 1	0 . . . . 5 . 7 8 .
—— ——, var. (H. Paperitzii, *Rchb.*)	. . . .	. . . .	. . . .
—— bupleuroides, *Gmel.*?	. . . .	. . . .	. . . . . 5 . . 8 .
—— ——, var. (H. glaucopsis, *Gren.*)	. . . .	. . . .	. . . .
—— dentatum, *Hoppe*	. . . . 5	. . . . . ? ? . . .	. . . . 8 .
—— glabratum, *Hoppe*	. . . 4 5 . 7 8 .	. . . .	0 . . . . 5 . . 8 .
—— villosum, *Jacq.*	1 2 3 4 . . 7 8 9	0 ? 2 . ? 5 6 . . 9	0 1 2 3 4 5 6 7 8 9
—— valdepilosum, *Vill.*	. . ? . . . . 8 .	. 1 2	. . . .
—— subnivale, *Gren. & Godr.*	. . . 4	. . . .	. . . .
—— Schraderi, *Schleich.*	. . 3 4 . . . 8 9	. 1 2 3 . 5 6 7 8 .	0 . . . . 5 6 7 . .
—— glanduliferum, *Hoppe*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 . 8 9	. 1 . . 4 5 . . . .
—— cerinthoides, *Linn.*	. . . . ? 9	. 1	. . ? . . . .
—— ——, var. (H. Reuteri, *Reichb.*)	. . . . 5	. . . .	. . . .
—— Morisianum, *Reichb.*	. 2 . 4	. . . .	. . . .
—— Lawsoni, *Vill.*	. . . 4 . . 7 ? .	0	. . . . ? .
—— vulgatum, *Koch*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (H. Bocconei, *Gris.*)	. . . .	. . . .	. . . .
—— murorum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (H. præcox, *Sch. Bip.*)	. . . .	. . . .	. . . .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5	50	F A G I . C N P . K	Crepis aurea.
0 . . 3 . 5 6 7 8 9	. . . 3 4 5	.	. A G I . . . . . K	—— alpestris.
. . . . . 5	. . . 3	.	. . . .	—— ——, var. (Barkhausia mucronata).
. . . .	. . . . ? .	50	. . . I	—— chondrilloides.
. . . . . 5 . . 8 .	. . . . . 5 . 7 . .	.	F A G I . . . P S K	—— biennis.
. . . .	. . . .	.	F . . I L . . . . K	—— nicæensis.
0 1 2 3 . 5 6 7 8 .	0 1 2 3 4 5 6 7 8 .	50	? A G I L C ? ? S K	—— tectorum.
0 . 2 3 . 5 . . 8 .	. . . 3 4 . . 7 . .	.	F A G I L C N P S K	—— virens.
. . . .	. . . .	50	. . . I L C N . . K	—— neglecta.
. . . . 4 5 6 7 8 9	0 1 . 3	.	F . ? I L C N P . K	—— pulchra.
. 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 . 9	.	. A G I . . . . . K	—— Jacquini.
0 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 8 .	.	F A G I L C N P S K	—— paludosa.
. . . . 7 . .	. . . .	.	. A G I . . . P . K	—— succisæfolia.
. . . .	. . . .	.	F A G I . . N P . .	—— pygmæa.
. . . 3 . . . 7 8 .	. . . 3 4 . . 7 . .	.	F A G I L . . P . K	—— blattarioides.
0 . 2 3 . 5 6 7 8 9	. . . 3 4 . . 7 . .	.	F A G ? L C . P . K	—— grandiflora.
. . . . . . 6 . 8 9	. . . . 4 . . 7 . .	.	F A G . . . . P . K	Soyeria montana.
. . . .	. . . . . 5	.	. A G	—— hyoseridifolia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Hieracium Pilosella.
. . . . 7 8 .	. . . .	.	. A . . . . . . S .	—— ——, var. (H. Peleterianum).
0 . . . . . . 7 8 9	. 1 . 3 4 5	.	. . G . . . N . . .	—— ——, var. (H. pilose|læforme).
. . . . . 5 . . 8 .	0 . . . . 8 .	.	. . G I L C N . ? K	—— bifurcum.
. . . . 8 .	. . . .	.	. . . .	—— ——, var. (H. Hausmanni).
. . 2 . . . 6 7 8 9	. . . 3 4	.	F A G I . . . . S K	—— furcatum.
. . . . 4 . 6 7 . .	. . . .	.	F A G . L	—— angustifolium.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P S K	—— Auricula.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N . . K	—— florentinum.
. . . . . 5 . . 8 .	. . . 3	.	F A G I . . . P S K	—— ——, var. (H. Bauhini).
. . . . 8 .	. . . 3	.	. . G I ? . . . S K	—— pratense.
. . . . . 5 6 7 8 9	. . . 3 . . . 7 . .	.	F A G ? . . . P S K	—— aurantiacum.
. . 2 . 4 5 6 . . 9	0 ? . 3 . . . ? . .	.	F A G I L C N . S .	—— sabinum.
. . . . 9	. . . .	.	. A	—— ——, var. (H. Laggeri).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L . . . . K	—— staticifolium.
0 1 2 3 4 5 6 7 . .	0 1 2 3 4 5 6 7 8 9	50	. . G I . . . . . K	—— porrifolium.
. . 2 . . . 6 . . 9	. . . .	.	. . . .	—— ——, var. dentatum.
. . . . . ?	. . . 3	50	F . . I	—— politum.
. . 2 . 4 5 6 . 8 9	. 1 2 3 4 5 . ? . 9	.	F A G I . C N . . K	—— glaucum.
. . . . . 5	. . . .	.	. . . .	—— ——, var. (H. Paperitzii).
. . . . . 5 . . 8 9	. . . .	.	. A G . . . . . . K	—— bupleuroides.
. . . . 4	. . . .	.	F	—— ——, var. (H. glaucopsis).
. . . . 8 .	. . . .	.	. A G	—— dentatum.
. . . . 7 8 9	. . 2 3 4 5 . 7 . .	.	F A G . . C	—— glabratum.
0 1 2 3 4 5 6 7 8 9	? 1 2 3 4 5 6 7 . 9	.	F A G I L C N P . K	—— villosum.
. . . .	. . . .	.	F	—— valdepilosum.
. . . .	. . . .	.	F	—— subnivale.
. . . 3 ? . . 7 ? ?	. . . ? 4 . . 7 . .	.	? A G	—— Schraderi.
. . . . . . 6 7 8 9	. . . 3 4	.	F A G . . . . . ? .	—— glanduliferum.
. . . .	. . . .	.	? A . . . . . P . .	—— cerinthoides.
. . . .	. . . .	.	F	—— ——, var. (H. Reuteri).
. . . .	. . . .	.	. . . .	—— Morisianum.
. . . .	. . . .	.	F A . . . . ? P . .	—— Lawsoni.
0 . 2 . 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— vulgatum.
. . . . 7 8 .	. . . .	.	. A G	—— ——, var. (H. Bocconei).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	.	F A G I L C ? P S K	—— murorum.
. . . . 8 .	. . . .	.	F A G	—— ——, var. (H. præcox).

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Hieracium murorum, var. (H. incisum, *Hoppe*).	. . . .	. . . .	. . . .
—— Schmidtii, *Tausch*	. . . .	. . . .	. . . .
—— rupestre, *All.*	1	. 1 . . . . 6 . . .	. . ? . . . . ? ? .
—— Jacquini, *Vill.*	1 . . . . . 7 8 .	. . . . . . 6 . . .	0 . . . 4 5 6 7 8 .
—— andryaloides, *Vill.*	1 2 . . . . . ? .	. . ? . . . . . 8 .	. . . . ? .
—— lanatum, *Vill.*	1 2 3 4 5 6 7 8 9	. 1 2 3 4	. . . . 4 . . . . .
—— amplexicaule, *Linn.*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (H. pulmonarioides, *Vill.*).	1 2 . 4 5 . 7 8 9	0 . 2 . 4 5 . . 8 .	0 . . . . 5 . . . .
—— alpinum, *Linn.*	. . 3 . . . 7 8 .	0 . 2 3 . 5 6 7 8 9	0 1 . . 4 5 6 7 . .
—— cydoniæfolium, *Vill.*	1 2	. 1 2 . 4	. . . . . 5 . . . .
—— albidum, *Vill.*	1 2 3 . . 6 7 . .	. . . . . . 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— prenanthoides, *Vill.*	1 2 3 4 5 . 7 8 9	. . 2 . 4 5 6 7 . .	. . 2 . 4 . . . 8 .
—— ochroleucum, *Schleich.*	. . 3 . . 6 . . .	. 1 2 . 4 5 6 . . .	. 1 . . . .
—— trichodes, *Griseb.* ?	. . . .	. . . .	. . . .
—— lævigatum, *Willd.*	. . . .	. . . .	. . . .
—— australe, *Fr.*	. . . .	. . . .	. . . .
—— sabaudum, *Linn.*	. . 3 4 5 . . 8 9	. . 2 . 4 . 6 . . .	. . 2 . . . . 7 8 .
—— boreale, *Fr.*	1 2 . 4 5	. 1 2 3 4 5 6 7 8 .	. 1 . . ? . 6 . . 9
—— umbellatum, *Linn.*	1 2 . . . . . 8 .	. . . . . . 6 . 8 9	0 1 2 3 4 . 6 7 8 9
Andryala integrifolia, *Linn.*	1 2 . . . . . 8 .	. . . .	. . . .
Xanthium strumarium, *Linn.*	? 8 9	. . . . 4 . 6 . . 9	. . 2 3 4 . 6 7 8 .
—— spinosum, *Linn.*	?	. . . .	. . . . 7 . .
Jasione montana, *Linn.*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .
Phyteuma pauciflorum, *Linn.*	1 2 3 4 5 . 7 8 9	. . 2 . 4 5 6 7 8 9	0 1 . . 4 5 . . 8 .
—— ——, var. (P. globulariæfolium, *Hoppe*).	. 2 . . . . . 8 .	0 . 2 . . 5	. . . 3 4 5 6 . 8 .
—— hemisphæricum, *Linn.*	1 2 3 . . . . 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 ? 7 8 9
—— humile, *Schleich.*	. . . .	. . . . . . 6 7 8 .	0 . ? . 4 . 6 7 . .
—— Sieberi, *Spreng.*	. . . .	. . . .	. . . .
—— orbiculare, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 8 9
—— Scheuchzeri, *All.*	. . . . 5 . 7 8 .	0 . . . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (P. Charmelii, *Vill.*)	. 2 3	. . . .	. . . .
—— Michelii, *Bert.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— nigrum, *F. W. Schmidt* ?	. . . . 5 6 . . .	. . . .	. . . . 8 .
—— spicatum, *Linn.*	. . . . 8 .	. . . . . . ? . . .	. . 2 . 4 . 6 . . .
—— Halleri, *All.*	1 2 3 4 5 6 7 8 9	0 . 2 . 4 5 6 7 8 9	. . 2 . . . 6 7 8 .
—— Balbisii, *A. DC.*	. 2 . 4	. . . .	. . . .
—— comosum, *Linn.*	. . . .	. . . .	. . 2 . 4 . 6 7 8 9
Campanula Zoysii, *Wulf.*	. . . .	. . . .	. . . .
—— rotundifolia, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (C. pusilla, *Haenke*)	1 2 3 4 5 . 7 8 9	0 1 2 . 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 9
—— ——, var. (C. pubescens, *Schmidt*).	. 2 9	. 1 2 . . . . . 8 .	. 1 . . 5 . . . .
—— ——, var. (C. cæspitosa, *Scop.*)	. . . . . 6 . . .	. . 2	. 1 2 . 5 . 7 8 .
—— ——, var. (C. carnica, *Schiede*)	. . . .	. . . .	. . . .
—— excisa, *Schleich.*	. . . .	. . . . . 5 6 7 8 .	0 . . . .
—— macrorhiza, *Gay*	1 2	. . . .	. . . .
—— Scheuchzeri, *Lam.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .
—— ——, var. (C. valdensis, *All.*)	. . . 4 . 6 7 8 .	. . 2 . 4 5 6 . 8 .	. . . .
—— rhomboidalis, *Linn.*	1 2 . . . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . . . .
—— bononiensis, *Linn.*	1 2 . . . . 7 8 .	. . . . 4	. . 2 . . . 6 7 8 .
—— rapunculoides, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 . 9	0 . 2 . 4 5 6 7 8 9
—— Trachelium, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— latifolia, *Linn.*	1 2 3 . . . 7 8 .	 9	. . . . 4 . . 7 . .
—— Erinus, *Linn.*	1 2 . . . . . 8 .	. . . .	. . . .
—— cenisia, *Linn.*	. . 3 . . 6 . 8 .	0 . 2 . . 5 . 7 8 .	. . . . 4 . . . . .
—— Elatines, *Linn.*	. . . . 5 6 7 8 9	0 . . . . ?	. . . . ? .
—— elatinoides, *Moretti*	. . . .	. . . .	. . . . . . 6 7 8 9
—— Morettiana, *Reichb.*	. . . .	. . . .	. . . .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . 3 . 5 . . 8 .	. . . 3 . . . . 8 .	.	F A G I . . . P . K	Hieracium murorum, var. (H. incisum).
. . . . 7 . .	. . . .	.	. A G ? . . . . S .	—— Schmidtii.
. . . .	. . . .	.	F . ?	—— rupestre.
. . . . 8 9	. . . .	.	F A G I . C N P . K	—— Jacquini.
. . . .	. . . .	.	F A	—— andryaloides.
. . . .	. . . .	.	F A . . L ? N ? . .	—— lanatum.
. 1 2 3 4 5 6 7 8 9	0 1 . 3 . . . 7 . .	.	F A G I L C N P . K	—— amplexicaule.
. . . 3 . 5 . 7 8 9	. . . 3 4	.	F A G . L C N P . .	—— ——, var. (H. pulmonarioides).
. . . 3 . . 6 7 8 9	. 1 2 3 4 5 . 7 . .	.	F A G I ? . ? . S K	—— alpinum.
. . . . ?	. . . .	.	F A G . . . . . S .	—— cydoniæfolium.
. . . 3 . . 6 7 8 9	. . . 3 . 5	.	F A G ? . . . P . K	—— albidum.
. . 2 3 . . . 7 . 9	0 . . 3	.	F A G I L C N P S K	—— prenanthoides.
. . . . . . 6 7 . .	. . . .	.	F A . . . . ?	—— ochroleucum.
. . . . 7 . .	. . . .	.	. . . .	—— trichodes.
. . . . 8 .	. . . .	50	. . G I	—— lævigatum.
. . . .	. . . .	50	. . G . L	—— australe.
. . . . . 5 . 7 8 .	. . . 3 4 . . 7 . .	50	F . . I L C . P . .	—— sabaudum.
0 . . 3 4 5 . 7 8 9	0 . . 3 4 . . 7 . .	50	F A G I L ? ? P S K	—— boreale.
. 1 2 3 4 5 6 7 8 9	0 1 . 3 . 5 . 7 . 9	50	F A G I L C N P S K	—— umbellatum.
. . . .	. . . .	.	. . . . L C N P . .	Andryala integrifolia.
. . . . 4 5 . 7 8 .	0 . . 3 . . . 7 . .	.	F A ? I L C . P . ?	Xanthium strumarium.
. 1	0 . . 3	.	? . . I L C N ? . K	—— spinosum.
. . . 3 4 5 6 7 8 .	0 1 . 3 . . . 7 . .	.	F A G I L C N P S K	Jasione montana.
. . . 3 . . 6 7 8 9	. . . 3 . 5	.	F A G . L . . P . K	Phyteuma pauciflorum.
. . . . . . 6 . . 9	. . . 3	.	F A G . . . . P . .	—— ——, var. (P. globulariæfolium).
0 . 2 3 . 5 6 7 8 9	. . 2 3 4 5 . . . 9	.	F A G I ? C . P . K	—— hemisphæricum.
. . . 3 . . 6 . . .	. . . .	.	. A	—— humile.
. . 2 3 4 . . 7 8 9	. 1 2 3 4 5 6 7 . 9	.	. . G I	—— Sieberi.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	.	F A G I L C N P . K	—— orbiculare.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	. A G I . . . . . K	—— Scheuchzeri.
. . . .	. . . .	.	F . . . . . . P . .	—— ——, var. (P. Charmelii).
0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 8 .	50	F A G I L C ? ? . K	—— Michelii.
. . . 3	. . . .	.	. A G . . . . P . K	—— nigrum.
0 1 2 . 4 . 6 . . 9	. . ? 3 . . . 7 . .	.	F A G . . . . P S K	—— spicatum.
0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 . .	.	F A G ? L C . ? . K	—— Halleri.
. . . .	. . . .	.	. . . .	—— Balbisii.
0 1 2 3 4 5 6 . 8 9	. 1 2 3 4 5 6 7 . .	.	. . . I	—— comosum.
. . . .	. . . . 7 . 9	50	. . G I	Campanula Zoysii.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— rotundifolia.
. . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . . 8 9	.	F A G I . . N P . K	—— ——, var. (C. pusilla).
. . . . 8 .	. . . .	.	. A G I	—— ——, var. (C. pubescens)
. . 2 3 4 . . . 8 9	0 1 . 3 4 5 6 7 . 9	50	? . G I L ? ? . . ?	—— ——, var. (C. cæspitosa).
0 . 2 . . . . . 8 .	. 1 . 3 4 . . 7 8 9	50	. . G I . . . . . K	—— ——, var. (C. carnica).
. . . .	. . . .	.	. A	—— excisa.
. . . .	. . . .	.	F . . . L	—— macrorhiza.
0 . 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 .	.	F A G I L C N P . K	—— Scheuchzeri.
0 1 . 3 4 5 . 7 8 9	. . . . 4 5 6 7 . .	.	F A . . L . . P . .	—— ——, var. (C. valdensis).
. . . .	. . . .	.	F A ? . ? . . ? . ?	—— rhomboidalis.
. . . . 4 5 6 7 8 9	0 . 2 3 4	50	F A . I L C N . . .	—— bononiensis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	50	F A G I L . . P S K	—— rapunculoides.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Trachelium.
. . . .	. . . . 7 . .	.	F A G . ? C N P S K	—— latifolia.
. . . .	. . . 3	.	F . . I L C N P . .	—— Erinus.
. . . .	. . . .	.	F A G	—— cenisia.
. . . .	. . . .	.	. . . I . . N . . .	—— Elatines.
. . . .	. . . .	.	. . . .	—— elatinoides.
. . . . 8 9	. . . 3 4 5	.	. . . .	—— Morettiana.

	0 (1 2 3 4 5 6 7 8 9)	1 (0 1 2 3 4 5 6 7 8 9)	2 (0 1 2 3 4 5 6 7 8 9)
Campanula Rainerii, *Perpent.*	. . . .	. . . .	. . 2 . . . 6 7 8 9
—— pyramidalis, *Linn.*	. . . .	. . . .	. . . . 4 . . . . .
—— patula, *Linn.*	1 . 3 4 5 6 7 . 9	0 1 2 . 4 5 6 7 8 .	. . 2 . 4 5 6 7 8 .
—— Rapunculus, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 . . 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— persicifolia, *Linn.*	1 . 3 4 5 . 7 8 .	. . 2 . 4 5 6 . . .	. . 2 . 4 . 6 7 8 9
—— petræa, *Linn.*	1	. . . .	. . . .
—— thyrsoides, *Linn.*	1 . 3 4 5 . 7 8 9	0 1 . . . . . 7 . .	. . . . 4 5 6 . ? .
—— spicata, *Linn.*	1 2 3 4 5 6 . 8 .	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 .
—— Cervicaria, *Linn.*	. . . .	. . . . ? .	. . 2 . . . . . 8 .
—— glomerata, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 . 9	0 1 2 3 4 5 6 7 8 9
—— alpina, *Jacq.*	. . . .	. . . .	. . . .
—— barbata, *Linn.*	1 . . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Allionii, *Vill.*	1 2 3 4 5 6 7 8 .	0 . 2 . . . ? ? . .	. . . .
—— sibirica, *Linn.*	. . . . 8 9	0	. . . . 8 9
—— Medium, *Linn.*	1 2	. . . .	. . . .
—— Alpini, *Linn.*	 9	. . . .	. . . .
Specularia Speculum, *DC.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	. . 2 . 4 5 6 7 8 9
—— hybrida, *DC.*	? . . . . . . 8 .	. . . .	. . . .
Vaccinium Myrtillus, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— uliginosum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9
—— Vitis-Idæa, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Oxycoccus, *Linn.*	. . . .	. . . .	. . . .
Arctostaphylos alpina, *Spreng*	. . . . . 6 . 8 .	. 1 . . . 5 6 7 . .	. . . . 4 5 6 7 8 9
—— officinalis, *Wimm. & Grab.*	1 2 . . . . 7 8 9	0 1 2 3 4 5 6 7 8 9	. . 2 . 4 5 6 7 8 9
Andromeda polifolia, *Linn.*	. . . .	. . . .	. . . .
Calluna vulgaris, *Salisb.*	1 2 3 4 . . 7 8 9	0 1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Erica carnea, *Linn.*	. 2 . . 5 . 7 . 9	. . . . . . 6 . 8 9	. . 2 . 4 5 6 7 8 9
—— arborea, *Linn.*	. . . .	. . . .	. . 2 3 4 . 6 7 8 .
Menziesia cærulea, *Sw.*	. . . .	. . . .	. . . .
Loiseleuria procumbens, *Desv.*	. 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
Rhododendron ferrugineum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— hirsutum, *Linn.*	. . . .	. . . . . . 6 . 8 .	. . 2 . 4 5 6 7 8 9
—— Chamæcistus, *Linn.*	. . . .	. . . .	. . . . 7 8 .
Pyrola rotundifolia, *Linn.*	1 2 3 4 . . . 8 .	0 . 2 . . . 6 . 8 .	. . 2 3 . 5 6 7 8 .
—— chlorantha, *Sw.*	. . . .	. . . .	. . . . 8 .
—— media, *Sw.*	. 2	. . ?	. . . .
—— minor, *Linn.*	1 . 3 . . . 7 8 .	. 1 2	. . . . 4 5 . . 8 .
—— secunda, *Linn.*	1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 . .	. . . . . 5 . 7 8 9
—— uniflora, *Linn.*	1 2 . . . . . 8 9	. 1 . . . . 6 7 . .	. . 2 3 4 5 6 7 8 9
Monotropa Hypopitys, *Linn.*	1 . . . . 6 7 8 .	0 . . . . . 6 . . .	. . . . 4 . . 7 8 .
Ilex Aquifolium, *Linn.*	1 . . 4 . 6 . 8 .	. . . . 4 . 6 7 . 9	. . 2 . 4 . 6 7 8 9
Phillyrea media, *Linn.*	1	. . . .	. . . .
Ligustrum vulgare, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Fraxinus excelsior, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .
—— Ornus, *Linn.*	. 2	. . . . . . 6 7 . 9	. . 2 . . . 6 7 8 9
Cynanchum Vincetoxicum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— laxum, *Bartl.*	. . . .	. . . .	. . . . 7 8 .
Vinca major, *Linn.*	?	. . . . . . 6 . . 9	. . 2 . 4 . 6 7 . .
—— minor, *Linn.*	1 2 . 4 . . 7 8 9	. . . . 4 . 6 . 8 9	0 . 2 . 4 5 6 7 8 9
Nerium Oleander, *Linn.*	. . . .	. . . .	. . . .
Menyanthes trifoliata, *Linn.*	. . . . 8 .	 9	. 1 2 . 4 . 6 . 8 .
Villarsia nymphoides, *Vent.*	. . . .	. . . .	. . 2 . 4 . 6 . . .
Chlora perfoliata, *Linn.*	1 2 . . . . 7 8 .	. . . . 4 . 6 . . 9	. . 2 . . . 6 7 8 .
—— serotina, *Koch*	. . . .	. . . .	. . . .
Erythræa Centaurium, *Linn.*	1 2 3 4 . . 7 8 9	0 1 . . 4 . 6 . 8 9	0 1 2 3 4 . 6 7 8 9
—— ——, var. (E. pulchella, *Fr.*)	1 2	. . . .	. . . . 7 8 .
Swertia perennis, *Linn.*	1 2 3 . . . . 8 .	. . . . 8 .	 9
Pleurogyne carinthiaca, *Griseb.*	. . . .	. . . .	. . . .
Gentiana lutea, *Linn.*	1 2 . . . . 7 8 9	0 1 2 3 . . 6 . . 9	. . 2 3 4 . 6 7 8 .
—— purpurea, *Linn.*	. . . . 8 .	. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 . .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
0	. . . .	.	. . . .	Campanula Rainerii.
. . . .	. . . . 7 8 9	50	. . . I	—— pyramidalis.
0 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 . .	.	F A G I . . . P S K	—— patula.
0 1 2 3 4 5 . . 8 9	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— Rapunculus.
0 1 2 3 4 5 . . 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— persicifolia.
. . . . 4	0	.	F	—— petræa.
. . . . 7 . .	. . . . . 5 . 7 . .	.	F A G	—— thyrsoides.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N . . K	—— spicata.
. . . . ? . . . 8 .	. ?	50	. A G I . . . . S K	—— Cervicaria.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P S K	—— glomerata.
. . . ? 4	. . . .	.	. A G . . . . . . K	—— alpina.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I . . . . S K	—— barbata.
. . . .	. . . .	.	F	—— Allionii.
0 1 . . 4 5	0 1 . 3 4 . . . 8 .	50	. . G I L C N . . K	—— sibirica.
. . . .	. . . . 7 . .	50	? . . . L C . . . K	—— Medium.
0 1 . . 4 5	0 1 2 3 . . 6 7 8 .	.	. . G I . . . . . K	—— Alpini.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4	.	F A G I L C N P . K	Specularia Speculum.
. 1 2 . 4 ? . . 8 .	0	50	F . G I L . N ? . K	—— hybrida.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P S K	Vaccinium Myrtillus.
0 . 2 3 . 5 6 7 8 9	. 1 2 3 4 5 6 7 . 9	.	F A G I L C ? P S K	—— uliginosum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C ? P S K	—— Vitis-Idæa.
. . . 3 9	. . . . 7 . .	.	? A G . . . . . S K	—— Oxycoccus.
. 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 8 9	.	F A G I . C . P S K	Arctostaphylos alpina.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . .	.	F A G I L C N P S K	—— officinalis.
. . . . . . 6 . 8 9	. . 2	.	F A G . . . . P S K	Andromeda polifolia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C ? P S K	Calluna vulgaris.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	. A G I L C N . . K	Erica carnea.
0 1 . . 4 9	0	.	. . . I L C N P . .	—— arborea.
. . . .	. . . . 7 . .	.	. . . . P S .	Menziesia cærulea.
0 . 2 3 4 . 6 7 8 9	. 1 2 3 4 5 . 7 . 9	.	F A G I . . . P S K	Loiseleuria procumbens.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 . .	.	F A G I L . . P . K	Rhododendron ferrugineum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	? A G I . . . ? . K	—— hirsutum.
0 . 2 3 4 5 . . 8 9	0 1 2 3 4 5 6 7 8 9	.	. . G I . . . . . K	—— Chamæcistus.
0 . 2 3 4 . . 7 8 9	0 1 2 3 4 5 . 7 . .	.	F A G I L C ? P S K	Pyrola rotundifolia.
. . . . 8 .	. . . . 7 . .	.	F A G . . . . P S .	—— chlorantha.
. 1 . 3 4 5 . . 8 .	. . . 3	.	. . G . . . . . S K	—— media.
. . 2 3 . . 6 7 8 9	0 . . 3 4 5 . 7 . .	.	F A G I L C N P S K	—— minor.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	.	F A G I L C N P S K	—— secunda.
0 . 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 8 9	.	F A G I . . . P S K	—— uniflora.
. . 2 3 . 5 . 7 8 .	0 1 2 . 4 5	.	F A G I L C N P S K	Monotropa Hypopitys.
0 1 2 3 4 5	0 1 . 3 . . . . 8 .	50	F A G I L C N P S .	Ilex Aquifolium.
. . 2 . 4	. . . .	.	. . . I L C N . . .	Phillyrea media.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Ligustrum vulgare.
0 . 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 . 9	.	F A G I L C N P S K	Fraxinus excelsior.
0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 9	50	? . G I L C N . . K	—— Ornus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Cynanchum Vincetoxicum.
. . . . . 5 . 7 8 .	. . . .	50	F . . I	—— laxum.
. . . . ? .	. 1 . 3 . . . 7 . .	50	F A . I L C N P . K	Vinca major.
0 1 2 3 4 5 . 7 8 .	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P . K	—— minor.
. 1 . . 4	. . . .	.	. . . . L C N . . .	Nerium Oleander.
. . . 3 4 5 6 7 8 9	. . 2 3 4 5 . 7 . .	50	F A G I L ? N P S K	Menyanthes trifoliata.
. . . .	. . . .	.	F A ? ? . C N . . K	Villarsia nymphoides.
0 1 2 . 4 5	0 1 . 3 4 5 . 7 . .	50	F A G I L C N P . K	Chlora perfoliata.
. . . . 4 5	. . . .	.	F A	—— serotina.
0 1 2 3 4 5 . 7 8 9	0 1	50	F A G I L C N P S K	Erythræa Centaurium.
. . . . . 5 . 7 8 .	. . . 3 . . . 7 8 .	.	F A G I L C N P S K	—— ——, var. (E. pulchella).
0 . . . . 8 .	. . . . . 5	.	F A G . . C . P . K	Swertia perennis.
. . . . 7 8 9	. . . . . 5 . 7 . .	.	. A G . . . . . . K	Pleurogyne carinthiaca.
0 . . 3 4 5 6 . 8 .	0 1 2 3 4 . . 7 .	50	F A G I L C N P . K	Gentiana lutea.
. . . .	. . . .	.	. A G . . C . . S K	—— purpurea.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Gentiana pannonica, *Scop.*	. . . .	. . . .	. . . . 8 9
—— macrophylla, *Bert.*	1 . 3 4 5 6 . 8 .	. . . .	. . . .
—— punctata, *Linn.*	. . . . . 6 7 8 .	0 1 2 . 4 5 6 7 . .	. . . . 4 5 6 7 8 9
—— ——, var. (G. campanulata, *Jacq.*).	. . . .	. 1	. . . . 8 .
—— cruciata, *Linn.*	1 2 3 4 . . 7 8 .	. . . 3 4 . 6 . . 9	. . 2 . 4 5 6 7 8 9
—— asclepiadea, *Linn.*	1 2 3 4 5 6 . 8 9	. . . . . . 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Pneumonanthe, *Linn.*	. . . . 8 9	. . . . . . 6 . . 9	. . 2 . 4 . . 7 . .
—— acaulis, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— alpina, *Vill.*	. 2 . . . . . 8 .	0 . . . . 5	. . 2 . 4 5 . 7 8 9
—— bavarica, *Linn.*	. . . . . 6 7 8 .	0 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 6 7 8 .
—— Rostani, *Reut.*	1 2 3 4 . 6 . . .	. . . .	. . . .
—— verna, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 . 2 3 4 5 6 7 8 9
—— ——, var. (G. æstiva, *Schult.*)	. . . .	. . . .	. . . . 8 .
—— pumila, *Jacq.*	1 2 3 . 5 6 . 8 .	. . . .	. . . . ? . . . . .
—— imbricata, *Froel.*	. . . . 5	. . . .	. . . .
—— prostrata, *Haenke*	. . . .	. . . .	. . . .
—— utriculosa, *Linn.*	. . . .	. . . .	. . 2 . 4 . 6 7 8 9
—— nivalis, *Linn.*	1 2 . 4 5 6 7 8 .	0 1 2 3 4 5 6 . 8 .	. . . 3 4 5 6 7 8 .
—— campestris, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 . 5 6 7 8 9	. 1 . . 4 5 . 7 8 .
—— Amarella, *Linn.*?	. . . .	0 . . . . 5 6 . . .	. . ? . 4 . ? . . .
—— germanica, *Willd.*	. . . .	0 . 2 . . 5 6 7 8 .	0 . 2 3 . . 6 7 8 9
—— ——, var. (G. obtusifolia, *Willd.*)	. . . .	0 . 2 . . 5	. . . . 4 . . 7 . .
—— tenella, *Rottl.*	. 2 3 . 5 6 7 8 9	0 1 2 . 4 5 6 7 8 .	. . . 3 . 5 . . . .
—— nana, *Wulf.*	. . . .	. . . .	. . . .
—— ciliata, *Linn.*	1 2 . . . . 7 8 .	. 1 2 3 . 5 6 . . .	0 . 2 3 . 5 6 7 8 9
Polemonium cæruleum, *Linn.*	. . . .	. . . . . 5	. . . . . 5 . . . .
Convolvulus sepium, *Linn.*	1 2 3 . . . 7 8 9	0 . . . . . 6 . 8 9	0 1 2 3 4 5 6 7 8 .
—— arvensis, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 . 8 9	. 1 2 . 4 5 6 7 8 9
—— Cantabrica, *Linn.*	1 2	. . . .	. . . . 8 9
Cuscuta europæa, *Linn.*	1 2 3 4	0 . 2 . . 5 6 . . .	0 1 2 3 4 5 6 7 8 .
—— Epithymum, *Linn.*	1 . 3 4 5 . 7 . 9	0 1 2 3 4 5 6 7 8 .	0 1 2 . 4 5 6 7 8 .
—— Epilinum, *Weihe*	. . . .	. . . .	. . . . 7 8 .
—— urceolata, *Kunze*	. 2	. . . .	. . . .
—— Cesatiana, *Bert.*	. . . .	. . . . . . 6 . . .	. . . .
—— planiflora, *Ten.*	. 2	. . . .	. . . .
Heliotropium europæum, *Linn.*	. . . 4 . . . 8 .	. . . . . . 6 . . .	. . . .
Asperugo procumbens, *Linn.*	1 2 . . . . . 8 .	. 1 2 . . . 6 . 8 .	. . . . . 5 . . . .
Echinospermum Lappula, *Lehm.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 . 8 9	0 1 2 . 4 5 6 7 8 .
—— deflexum, *Lehm.*	. . . .	. . 2	. . . . . 5 6 . 8 .
Cynoglossum officinale, *Linn.*	. 2 3 . . . . 8 .	0 1 2 3 4 5 6 . . 9	. . 2 . 4 5 6 7 8 9
—— pictum, *Ait.*	 9	. . . . . . ? . . .	. . 2 . 4 . . 7 8 .
—— montanum, *Lam.*	. 2 3 4 5 . . 8 .	. . . .	0 . . . . 5 . . . .
—— Dioscoridis, *Vill.*	1 2 3	. . . .	. . . .
Omphalodes verna, *Moench*	. . . .	 9	. . . . 7 8 .
Anchusa officinalis, *Linn.*	. . . .	0 . 2 3 4	. 1 2 3 4 5 6 7 8 .
—— italica, *Retz.*	1 2	. . . . . . 6 . 8 .	. 1 2 . . 5 . 7 8 .
—— Barrelieri, *DC.*	. 2 3 4	. . . . . . ? . . .	. . . .
Lycopsis arvensis, *Linn.*	1 2 . . . 6 . 8 .	. 1 2 3 4 5 6 . 8 9	. 1 2 . 4 5 6 7 8 9
Symphytum officinale, *Linn.*	1 2 . 4 . 6 7 8 .	. . . . 4 . 6 . . 9	. . 2 . 4 . 6 . . .
—— ——, var. (S. patens, *Sibth.*)	. . . .	. . . .	. . . .
—— bulbosum, *Schimp.*	1 2	. . . .	. . 2 . . . .
—— tuberosum, *Linn.*	1 2 . . . . . 8 .	. . . . . . 6 . . 9	. . 2 . 4 . 6 7 8 9
Onosma echioides, *Linn.*	1 2	. . . .	. . . .
—— stellatulum, *Waldst. & Kit.*	. . . . 8 .	. 1 2 . 4 . 6 . . .	. . . .
Cerinthe major, *Lam.*	1 . . . . 6 . . .	. . . . 8 .	. . . .
—— minor, *Linn.*	. . . . . 6 7 8 9	. . . . . . 6 . . .	. 1 . . . . 6 7 8 9
—— ——, var. (C. maculata, *Bieb.*)	. 2 . . . . . ? .	. . . .	. . . .
—— alpina, *Kit.*	. 2	0	. . . .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . 2 9	. . . .	50	. . G I . . . . . K	Gentiana pannonica.
. . . .	. . . .	.	F . . . . . . P . .	—— macrophylla.
. . 2 3 . . 6 7 8 9	. . . 3 4 . . 7 . .	.	F A G . . . . . . K	—— punctata.
. . . 3 . . . . 8 9	. . . 3 4	.	. . G	—— ——, var. (G. campanulata).
0 . 2 3 4 5 6 7 8 9	0 . 2 3 4 5 . 7 . .	50	F A G I L C N P . K	—— cruciata.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C . . . K	—— asclepiadea.
. . . . . 5 . 7 8 .	0 . . 3 . . . 7 . .	50	F A G I L C ? P S K	—— Pneumonanthe.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— acaulis.
0 . 2 3 4 5 6 7 8 .	. . . 3 4	.	F A G I ? . . P . K	—— alpina.
. . 2 3 4 . 6 7 8 9	0 1 . 3 4 5	.	F A G I . . N . . K	—— bavarica.
. . . .	. . . .	.	F	—— Rostani.
0 . 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 . 9	50	F A G I L C N P . K	—— verna.
. . . 3 4 5 . 7 8 .	. . . 3	.	F A G I . . . P . K	—— ——. var. (G. æstiva).
. . . . 9	. . . . 7 . 9	.	. . G I . . N . . K	—— pumila.
. . . . 7 8 9	. . . . 4	50	. . G I . . ? . . .	—— imbricata.
. . . . 8 9	. . . .	.	. . G	—— prostrata.
0 1 2 3 4 5 . . 8 9	0 1 . 3 4 5 6 7 . .	50	. A G I . C N . . K	—— utriculosa.
. . 2 3 4 5 6 7 8 9	. . 2 3 4 5 6 . . .	.	F A G I . . N P S K	—— nivalis.
. . 2 . . 5 . 7 . .	. 1 . . . 5 . . 8 .	.	F A G I L C ? P S K	—— campestris.
. 1 . 3 . . 6 . 8 .	. . . . 7 . .	.	. A . . . . . . S K	—— Amarella.
. . 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . .	50	. A G I . . . . S K	—— germanica.
. . 2 . . 5 . 7 8 9	. . . .	.	. A G . . . . . . K	—— ——, var. (G. obtusifolia).
. . . 3 . . 6 7 8 9	. . . . 7 . .	.	F A G . . . . P S K	—— tenella.
. . . . 8 .	. . . . . 5	.	. . G . . . . . . K	—— nana.
0 . . 3 4 5 . 7 8 9	. 1 2 3 4 5 6 7 8 .	50	F A G I L C N P . K	—— ciliata.
. . . . 7 . .	. . . . 7 . .	.	. A G I . . . ? S K	Polemonium cæruleum.
. 1 2 . . 5 6 7 8 9	0 1 . 3 4 5 . . 8 .	50	F A G I L C N P S K	Convolvulus sepium.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— arvensis.
. 1 2 . 4 5	0 1	50	F . . I L C N P . K	—— Cantabrica.
. . 2 . 4 5 6 7 8 .	0 1 2 3 4 5	50	F A G I ? C N P S K	Cuscuta europæa.
. 1 2 3 4 5 . 7 8 9	0 1 2 3 . 5 . . 8 .	.	? A G I L C N P . K	—— Epithymum.
. . . . . 5 . . 8 9	. . . 3	.	. A . . . . . . S K	—— Epilinum.
. . . .	. . . .	.	. . . . L	—— urceolata.
. . . .	. . . .	.	. . . .	—— Cesatiana.
. . . . 4 . . 7 8 .	. . . .	.	. . . . . . N . . .	—— planiflora.
. . . . 4 . . 7 . .	0 . . . 4	50	F A . I L C N P . K	Heliotropium europæum.
. . . . 4 5 . 7 8 .	0 1 . 3	.	F A G I L C N P S K	Asperugo procumbens.
. . 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 8 .	50	F A G I L C ? P S K	Echinospermum Lappula.
. . . 3 . . . 7 8 9	. . . 3 4	.	. A G . . C . . S K	—— deflexum.
0 1 2 3 4 5 6 7 8 .	0 . 2 3 . . . 7 . 9	50	F A G I L C N P S K	Cynoglossum officinale.
. . . . 4	0 1 . 3	50	F . . I L C N P . .	—— pictum.
. 1 2 3 4	. 1 2 . 4	50	F A . I . C N P . K	—— montanum.
. . . .	. . . .	.	F . . . . . . P . .	—— Discoridis.
. 1	. 1 . 3 . . . . 8 .	.	. . G I L C N . . K	Omphalodes verna.
. . . 3 4 5 6 7 8 9	0 1 . . 4 5	.	F A . I L . . . S K	Anchusa officinalis.
. 1 . . 4	0	.	F A . . L C N ? . .	—— italica.
. . . .	. . . .	.	. . . . L C N . . K	—— Barrelieri.
. . 2 . 4 5 6 . 8 9	0 . . 3	.	F A G I L C N P S K	Lycopsis arvensis.
0 1 2 3 4 5 6 . 8 .	0 1 . 3 4 5	50	? A G I L C N P S K	Symphytum officinale.
. . . .	. . . 3	.	. . . . . . N . . ?	—— ——, var. (S. patens).
. . . .	. . . 3	.	. . . I . C N . . .	—— bulbosum.
. . . . 4 . . . 8 .	0 1 2 3 . . . 7 8 .	50	F . G I L C N P . K	—— tuberosum.
. . . . . ? . 7 . .	. . . . 7 . .	50	F A . I L . . P . K	Onosma echiodes.
. . . . 4 5 . 7 8 .	0	.	. A . I ? C N . . K	—— stellatulum.
. . . .	. . . .	50	. A . . . C N . . K	Cerinthe major.
. . . . 4 5 . 7 . .	0 1 . 3 . . . . 8 9	50	F . G I L C . . . ?	—— minor.
. . . .	. . . ?	.	. . . I . . N . . K	—— ——, var. (C. maculata).
. . . . 8 9	. . . .	.	. A G . . . . P . K	—— alpina.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Echium vulgare, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— pustulatum, *Sibth. & Sm.*	. . . .	. . . .	. . . . 8 .
—— italicum, *Linn.*	. . . . 8 .	. . . .	. . . . 4 . . . . .
Pulmonaria officinalis, *Linn.*	1 2 . . . 6 7 8 9	. . . .	. . 2 . 4 5 6 7 8 9
—— angustifolia, *Linn.*	. . 3 . . . . 8 .	. . . . 4	. . 2 . 4 . 6 7 8 .
—— ——, var. (P. azurea, *Bess.*)	1 2	. . . . . 5	. . . . 4 . . . 8 .
—— mollis, *Wolff*	. 2 . . . . . 8 .	0	. . . . 8 .
Lithospermum officinale, *Linn.*	1 2 . 4 . . 7 8 9	. . . .	. 1 2 . 4 . 6 7 8 9
—— purpureo-cæruleum, *Linn.*	1 2 3 . . . . 8 .	. . . .	. . 2 . . . 6 7 8 9
—— graminifolium, *Viv.*	. . . .	. . . .	. . . .
—— arvense, *Linn.*	1 2 3 4 5 6 7 8 9	0 . 2 . 4 . 6 7 8 9	. 1 2 . 4 5 . 7 8 9
Myosotis palustris, *With.*	1 . 3 . . . 7 8 .	. 1 2 . 4 . 6 . 8 9	0 . 2 3 4 5 6 7 8 .
—— cæspitosa, *Schult.*	. ?	0 . 2	. . . . 7 8 .
—— intermedia, *Link*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— sylvatica, *Hoffm.*	1 2	. . . .	. . . . 7 8 .
—— ——, var. (M. alpestris, *Schmidt*)	1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— hispida, *Schlecht.*	1 2 . . . 6 . . 9	. . . .	. . . . 7 8 .
—— versicolor, *Pers.*	. . 3 . 5 6 . . .	. . . .	. . . . 7 8 .
—— stricta, *Link*	. . . .	. . . .	. . . . 7 8 .
Eritrichium nanum, *Schrad.*	1 . 3 4 . . . 8 9	0 . 2 . 4 5 6 7 8 .	0 . . 3 4 5 6 . 8 .
—— ——, var. (E. Hacquetii, *Koch*)	. 2	. . . .	. . . .
Solanum villosum, *Lam.*	 9	. . . .	. . 2 . 4 . . 7 8 .
—— miniatum, *Bernh.*	1 2	. . . .	. . . . 7 8 .
—— nigrum, *Linn.*	1 2 . . . 6 . 8 .	0 . . 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Dulcamara, *Linn.*	1 2 3 4 . 6 7 8 9	0 1 2 . 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 .
Physalis Alkekengi, *Linn.*	1 . . . . . . 8 .	. . . . . . 6 . 8 9	. . 2 . . . . 7 8 .
Atropa Belladonna, *Linn.*	1 . . 4	. . . . 7 . .	. . 2 . . . . 7 . .
Scopolina atropoides, *Schult.*	. . . .	. . . .	. . . .
Hyoscyamus niger, *Linn.*	1 2 . . 5 6 7 8 9	. 1 2 3 4 5 6 7 . 9	. . 2 . 4 5 . 7 8 9
Datura Stramonium, *Linn.*	. . . . 8 .	. . . . . . 6 . . 9	. . 2 . 4 . . . . .
—— ——, var. (D. Tatula, *Linn.*)	. . . .	. . . .	. . . .
Verbascum Thapsus, *Linn.*?	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .
—— thapsiforme, *Schrad.*	1 2 3 4	. 1 2 3 4 5 6 . 8 9	. . ? . 4 . 6 7 8 9
—— phlomoides, *Linn.*?	1 2 . . . . . 8 9	. . . . . . 6 . . 9	. . 2 . 4 . 6 7 8 .
—— montanum, *Schrad.*	. 2 3 . . . . 8 .	. . . .	. . . . 4 5 . . 8 .
—— pulverulentum, *Vill.*	. . . . 8 .	. . . . 4	0 1 2 . 4 . 6 7 . 9
—— Lychnitis, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (V. micranthum, *Moretti*).	. . . .	. . . .	. . 2 . . . .
—— nigrum, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (V. lanatum, *Schrad.*)	. . . .	. . . .	. . . . 7 8 .
—— phœniceum, *Linn.*	. . . . 8 9	 9	. . . .
—— Blattaria, *Linn.*	1 2 . . . . . 8 9	. . . . . . 6 . . 9	. . 2 . . . 6 7 8 9
—— sinuatum, *Linn.*	1 2	. . . . 4	 9
Scrophularia nodosa, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Ehrharti, *C. A. Stev.*?	. 2 . . . . . ? .	. . . . . . ? . . .	. 1 2 . 4 . . 7 8 .
—— Balbisii, *Hornem.*	. 2	. . . .	. . . .
—— canina, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 . 4 . 6 . 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (S. atropurpurea, *Moretti*).	. . . . 8 .	. . . .	. . 2 . . . . 7 . .
—— Hoppei, *Koch*	1 2 . . . 6 . 8 .	. . . .	. . . . 7 8 ?
—— vernalis, *Linn.*	1 2 3	. . . .	. . . . 7 8 9
Gratiola officinalis, *Linn.*	1 . . . . . . 8 .	. . . . . . 6 . . 9	0 . 2 . 4 . 6 7 8 .
Digitalis purpurea, *Linn.*	. . . .	. . . . 8 .	. . . .
—— grandiflora, *Lam.*	1 . 3 4 5 . 7 8 .	. . . . . . 6 7 8 9	. . 2 . 4 . 6 7 8 9
—— lutea, *Linn.*	1 2 3 4 . . . 8 9	. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ferruginea, *Linn.*	. . . .	. . . .	. . . .
Antirrhinum majus, *Linn.*	1 2 3 4 . . . 8 .	. . . . . . 6 . . 9	. . 2 . . . . 7 . .
—— Orontium, *Linn.*	1 2 3 4 . . 7 8 9	. . . . . 5 6 . . 9	. 1 . . 4 . 6 7 8 .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C ? P S K	Echium vulgare.
. . . .	. . . .	.	. . . I . C N . . .	—— pustulatum.
. . . . 4	0 1 . 3	.	. A . I L C N P . K	—— italicum.
0 . . 3 4 5 6 7 8 .	0 1 . 3 4 . . 7 8 .	50	F A G I L C N P S K	Pulmonaria officinalis.
. . . . 4 5 . 7 8 9	. . . 3	50	F A G I L . . P S K	—— angustifolia.
. . . . 7 8 .	. . . .	.	. . G I ? . . . . K	—— ——, var. (P. azurea).
. . . .	. . . .	.	. ? G I ? ? . P . K	—— mollis.
0 . 2 . 4 5 . 7 8 .	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	Lithospermum officinale.
. 1 2 . 4 5 6 . 8 .	0 1 2 3 . 5 . . 8 .	50	F A G I L C N P . K	—— purpureo-cæruleum.
. . . .	0 1 . 3	.	. . . . . C	—— graminifolium.
. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P S K	—— arvense.
. . . 3 4 5 . 7 8 9	0 1 . 3 4 5 . 7 8 .	.	F A G I L C N P S K	Myosotis palustris.
. . . . 7 8 .	. . . 3	.	F A G . . . . P S K	—— cæspitosa.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— intermedia.
. . . 3 4 5 6 7 8 9	. . . 3 . . . 7 8 .	.	F A G I ? . . P S K	—— sylvatica.
0 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 8 9	.	F A G I L C N P S K	—— ——, var. (M. alpestris).
. 1 . . . 5 . 7 8 .	. . . .	50	F A G I L C ? P S K	—— hispida.
. . . .	. . . 3	.	F A G I L C ? P S K	—— versicolor.
. . . . . 5 . 7 8 .	. . . .	.	F A G ? . . . P S K	—— stricta.
. . . 3 ? . 6 . 8 9	. . 2 3 4 5 . 7 . .	50	F A G I . . . . . K	Eritrichium nanum.
. . . .	. . . .	.	F . . I	—— ——, var. (E. Hacquetii).
. 1 . . . 5 . 7 . .	. . . .	.	. A . I . . ? . ? K	Solanum villosum.
. 1 . . . 5	0 . . 3	.	? A G I L C N P S K	—— miniatum.
. . ? 3 4 5 6 7 8 .	0 1 . 3 4 5 6 7 8 .	50	F A G I L C N P S K	—— nigrum.
0 . . 3 4 5 . 7 8 .	0 1 . 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— Dulcamara.
. . 2 3 4 5 6 7 . .	0 1 . 3	50	F A G I L C N P . K	Physalis Alkekengi.
. 1 . . 4 5	0 1 . 3 4	50	F A G I L C N P . K	Atropa Belladonna.
. . . .	. . . .	50	. . G I . . . . . K	Scopolina atropoides.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	.	F A G I L C N P S K	Hyoscyamus niger.
. . 2 . 4 5 . 7 8 .	0 1	.	F A G I L C N P S K	Datura Stramonium.
. . . .	. . . 3	.	. . . . L C . P . K	—— ——, var. (D. Tatula).
0 1 2 3 . 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P S K	Verbascum Thapsus.
. . . 3 . 5 6 7 8 9	. . . 3 4	50	F A G I L C N P S K	—— thapsiforme.
. . 2 . 4 5	0 1 . 3	.	F A G I L C N P . K	—— phlomoides.
. . . . 8 .	. . 2 3	.	F A . . L C . P . K	—— montanum.
. . 2 . 4 5 . . 8 .	0 1 . 3	.	F A G I L C N P . K	—— pulverulentum.
. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . . 7 . .	50	F A G I L C ? P S K	—— Lychnitis.
. . . . 4 9	. . . 3	.	F . . . . C N . . .	—— ——, var. (V. micranthum).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— nigrum.
. 1	. . . 3	.	. . G I . C . . . K	—— ——, var. (V. lanatum).
. . . . 4	0 . . . . 8 .	50	. . G I . C N . . K	—— phœniceum.
0 1 . 3 4 5	0 1 . 3 . 5	50	F A G I L C N P . K	—— Blattaria.
. . . .	0	.	F . . I L C N P . .	—— sinuatum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	.	F A G I L C N P S K	Scrophularia nodosa.
. . . . 4	0 1 . 3	.	F A G I . . . ? S K	—— Ehrharti.
. . . .	. . . .	.	. . . . L . . P . K	—— Balbisii.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A ? I L C N P . K	—— canina.
. . . . 8 9	. . 2 3 4 5 6 7 . .	.	. . . . . C	—— ——, var. (S. atropurpurea).
. . 2 3 4 5 6 . 8 9	. . . . 4 . . 7 . .	.	F A G I . . N P . .	—— Hoppei.
. . . . 4 5	0 1 2 3 4 . . 7 . .	50	F A G ? L C N . S K	—— vernalis.
. . 2 3 . 5 . 7 . 9	0 . . 3 . . . 7 . .	50	F A G I L C N P . K	Gratiola officinalis.
. . . .	. . . . 7 . .	.	F . . . . . . P S ?	Digitalis purpurea.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . .	50	F A G I L . . P . K	—— grandiflora.
0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 . .	.	F A G I L C N P . K	—— lutea.
. . . .	. . . . . 5 . 7 . .	50	. . . I ? C N . . K	—— ferruginea.
. 1 2 . 4 5 . . 8 .	. . . . 8 .	.	F A G I L C N P . ?	Antirrhinum majus.
. . 2 . 4 5 6 . 8 9	0 1 . 3 4 5	.	F A G I L C N P . K	—— Orontium.

	0 (1 2 3 4 5 6 7 8 9)	1 (0 1 2 3 4 5 6 7 8 9)	2 (0 1 2 3 4 5 6 7 8 9)
Linaria Cymbalaria, *Mill.*	. . . . . . 7 8 .	. . . . . . 6 7 8 9	. 1 2 3 4 . 6 7 8 9
—— spuria, *Mill.*	1 2 . . . . . 8 .	. . . .	. . . . 7 8 .
—— Elatine, *Mill.*	1 2 . 4 . . . 8 .	. . . . . . 6 . . 9	. . 2 . . . . 7 8 .
—— minor, *Desf.*	1 2 3 4 5 6 . 8 .	0 1 2 3 4 5 6 7 8 .	0 1 2 . 4 5 6 7 8 .
—— Pelisseriana, *Mill.*	. 2	. . . .	. . . .
—— origanifolia, *DC.*	1 2	. . . .	. . . .
—— supina, *Desf.*	1 2 3 4 5 6 7 8 9	0 . . . 4 . . . 8 .	. . . .
—— alpina, *Mill.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9
—— simplex, *DC.*	1 2 3 4 . 6 . 8 .	. . . .	. . . .
—— striata, *DC.*	1 2 3 4 5 6 7 8 .	. . . . 8 .	. . . .
—— chalepensis, *Mill.*	?	. . . .	. . . .
—— vulgaris, *Mill.*	. . . . . . 7 8 .	0 . 2 . 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— genistifolia, *Mill.*	. . . . . 6 7 8 .	. . . . ? .	. . . .
—— italica, *Trev.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 . . 7 . .	. . . . ? . . . . .
Anarrhinum bellidifolium, *Desf.*	. . . .	. . . . . . ? . . .	. . 2 . . . . . 8 .
Erinus alpinus, *Linn.*	1 2 3	. . . . ? .	. . . .
Veronica scutellata, *Linn.*	. . . .	. . . . 4	. . . .
—— Anagallis, *Linn.*	1 2 3 4 . . 7 8 9	0 . 2 . 4 5 6 . 8 9	0 . 2 3 4 5 6 7 8 .
—— Beccabunga, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— urticifolia, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 9
—— Chamædrys, *Linn.*	1 2 3 4 . 6 7 8 9	. 1 . . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— montana, *Linn.*	. . . .	. . . .	. . . . 8 .
—— officinalis, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Allionii, *Vill.*	1 2 . 4 5 6 7 8 .	0	. . . .
—— aphylla, *Linn.*	1 2 . . 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 2 . 4 5 6 7 8 9
—— prostrata, *Linn.*	. 2 . 4 5 6 7 . .	. . . 3	. . . . . 5 . 7 8 .
—— austriaca, *Linn.*	. . ?	. . . .	. . . . 8 .
—— Teucrium, *Linn.*	1 2 . . . 6 7 8 .	 9	. . 2 . 4 5 6 . . .
—— ——, var. (V. latifolia, *Linn.*)	. 2 . . . . 7 . .	. . . .	 9
—— longifolia, *Linn.*	. . . .	. . . .	. . . .
—— spicata, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (V. nitens, *Host*)	. . . .	. . . .	. . . .
—— bellidioides, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 . 5 6 7 8 .	0 1 . 3 4 5 6 7 8 9
—— fruticulosa, *Linn.*	1 2 . 4 . . 7 8 9	0 . . . . . . 7 8 .	. . 2 . 4 5 . 7 8 9
—— saxatilis, *Jacq.*	1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— alpina, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— serpyllifolia, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— acinifolia, *Linn.*	1 . . . . . 7 8 .	. . . .	. . . . . . 6 . . .
—— arvensis, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— verna, *Linn.*	. . 3 . . 6 . 8 9	. . . . . 5 6 . . .	. . . . 4 5 . 7 8 .
—— succulenta, *All.*	. . . . . 6 . . .	. . . .	. . . .
—— triphyllos, *Linn.*	. . . . 8 .	. . . .	. . 2 . 4 . 6 7 8 .
—— præcox, *Linn.*	. . . . . 6 7 . .	. . . . 4	. . . .
—— agrestis, *Linn.*	1 2 . 4 . . . 8 .	. . . . . . 6 7 . 9	. . 2 . . 5 6 7 8 .
—— polita, *Fries*	. 2 . . . 6 . . .	. . . .	. . . . 4 5 . 7 8 .
—— Buxbaumii, *Fries*	1 2 . . . . 7 8 .	. . . . . . 6 . . .	. . 2 3 4 5 6 7 8 9
—— hederæfolia, *Linn.*	. 2 . 4 . . 7 8 9	. . . .	. . 2 . 4 5 6 7 8 .
Pæderota Bonarota, *Linn.*	. . . .	. . . .	. . . . 8 9
—— Ageria, *Linn.*	. . . .	. . . .	. . . .
Wulfenia carinthiaca, *Jacq.*	. . . .	. . . .	. . . .
Lindernia pyxidaria, *All.*	. . . .	 9	. . . . . . 6 . . .
Limosella aquatica, *Linn.*	. . . .	 9	0 . 2 . . . .
Lathræa Squamaria, *Linn.*	. . . . 8 .	. . . . . . 6 . . 9	. . . . . . 6 . . .
Orobanche cruenta, *Bert.*	1 2 . 4 . . . ? .	. . . . 8 9	0 1 2 . 4 . . 7 8 9
—— Rapum, *Thuill.*	. . . . ? .	. . . . . . 6 . . 9	. . 2 . 4 5 6 7 8 .
—— Epithymum, *DC.*	1 2 3 4 . . . 8 .	. 1 2 3 4 5 6 7 . 9	0 . 2 . 4 . . 7 8 .
—— Galii, *Duby*	. . . . 8 9	. . . . . . ? . . .	. . . .
—— rubens, *Wallr.*	. . . .	. . . .	. . . .
—— loricata, *Reichb.*	. . . .	. . . .	. . . . 8 .
—— Picridis, *F. W. Schultz*	. . . .	. . . .	. . . . 8 .

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
0 1 2 . 4 5	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P . ?	Linaria Cymbalaria.
. . . .	0	50	F A . I L C N P . K	—— spuria.
. . . . . 5	0	.	F A G I L C N P S K	—— Elatine.
. . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P S K	—— minor.
. . . .	. . . .	.	. . . I L C N P . .	—— Pelisseriana.
. . . .	. . . .	.	. . . . P . .	—— origanifolia.
. . . .	. . . .	.	F . . . L C . P . .	—— supina.
. . 2 3 4 5 6 7 8 9	. . 2 3 4 5 6 7 . 9	.	F A G I ? . N P . K	—— alpina.
. . . .	. . . .	.	. . . I L . ? . . .	—— simplex.
. . . .	. . . .	.	F A . . L . . P S .	—— striata.
. . . . 4	0	.	. . . I L C N . . .	—— chalepensis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P S K	—— vulgaris.
. . . .	. . . .	.	F . G I ? . . . . K	—— genistifolia.
. . . . . 5 . 7 8 .	. . . .	.	F A G . L . . . . K	—— italica.
. . . .	. . . .	.	F . . . L . . P . .	Anarrhinum bellidifolium.
. . . .	. . . .	.	F A . . L . N P . .	Erinus alpinus.
. . . . . 5 . . 8 9	. . . 3	.	F A G ? . C N P S K	Veronica scutellata.
. . 2 3 4 5 6 . 8 9	0 1 . 3 4 5 . 7 . .	50	F A G I L C N P S K	—— Anagallis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Beccabunga.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P . K	—— urticifolia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9	50	F A G I L C N P S K	—— Chamædrys.
. . . .	. . . .	.	F A G ? L C N P S K	—— montana.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— officinalis.
. . . .	. . . .	.	F	—— Allionii.
. . 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 8 9	.	F A G I L C N P . K	—— aphylla.
. . . 3 . 5 . 7 8 9	0 . . 3	50	F A G . L C N P . K	—— prostrata.
. . . .	. . . . 7 . .	50	. A . I . . . . . K	—— austriaca.
0 1 . . 4 9	0 1 . 3 4 5 6 7 . 9	.	F A G I . . N P . K	—— Teucrium.
. . . . 4 5 . 7 8 9	. . 2 3 . . . 7 . .	.	F . . I . . . P . ?	—— ——, var. (V. latifolia).
. . . .	. . . . 8 .	.	. ? ? I . . . . S K	—— longifolia.
. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I ? C N P S K	—— spicata.
. . . . . 5 . . 8 .	. 1 . 3 . . 6 . . .	50	. . . I . . . . . K	—— ——, var. (V. nitens).
0 . 2 3 . 5 6 7 8 9	. . 2 3 4 5 . 7 . .	.	F A ? ? L . . P . K	—— bellidioides.
. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C . P . K	—— fruticulosa.
0 . 2 3 4 5 6 7 8 9	0 . 2 3 4 5 6 7 . 9	50	F A G I L C ? P S K	—— saxatilis.
0 . 2 3 . 5 6 7 8 9	. . . 3 4 5 . 7 . 9	.	F A G I . . N P S K	—— alpina.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 . 8 .	50	F A G I L C N P S K	—— serpyllifolia.
. . . .	. . . 3 . . . . 8 .	.	F A G I L C N P . K	—— acinifolia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— arvensis.
. . . . 4 5 . . 8 .	. . . .	.	F A G ? ? ? N P S K	—— verna.
. . . .	. . . .	.	. . . .	—— succulenta.
. . . 3 4 5 . 7 8 .	. . . 3	.	F A G ? L . . P S K	—— triphyllos.
. . . .	. . . .	.	? A ? ? . . N P . K	—— præcox.
. . . . 7 8 .	0 1 . 3	.	F A G I ? C N P S K	—— agrestis.
. . . . 4 5 . 7 8 9	. . . .	.	F A G I L C ? P S K	—— polita.
0 1 2 3 4 5 6 . . 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Buxbaumii.
0 1 2 3 4 5 . 7 8 9	0 1 . 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— hederæfolia.
0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9	.	. . G I . . . . . K	Pæderota Bonarota.
. . . .	. 1 . 3 4 5 6 7 8 9	50	. . G I . . . . . K	—— Ageria.
. . . .	. . . . 7 . .	.	. . G	Wulfenia carinthiaca.
. . . .	. . . 3 . . . 7 . .	.	. . G . . . . . . K	Lindernia pyxidaria.
. . . . 7 8 .	. . . .	.	F A G . . . . P . K	Limosella aquatica.
. . . . 4 5 . . 8 9	. . . 3 . . . 7 8 .	.	F A G ? L . N P S .	Lathræa Squamaria.
0 1 2 3 4 5 . 7 8 .	0 1 . 3 4 5	.	F A G I L C N P . K	Orobanche cruenta.
. . . . 4	? . . . . . . ? ? .	.	. A . . L C . P . .	—— Rapum.
. . 2 3 . 5 6 7 8 9	. . 2 3 4	.	F A G I L C N P S K	—— Epithymum.
. . . . 7 8 9	. . . .	.	F A G I L . . P . K	—— Galii.
. . . . . 5 . 7 8 .	0	.	F A ? ? . . . P . K	—— rubens.
. . . .	. . . .	.	. A . . . C	—— loricata.
. . . .	. . . .	.	F . G I L	—— Pieridis.

	0 (1 2 3 4 5 6 7 8 9)	1 (0 1 2 3 4 5 6 7 8 9)	2 (0 1 2 3 4 5 6 7 8 9)
Orobanche minor, *Sutt.*	1 2	. . . .	? . 2 . 4 . . 7 8 .
—— amethystea, *Thuill.*	. . . 4 . 6 . 8 .	. . . .	. . . .
Phelipæa cœrulea, *C. A. Mey.*	1 . . . . 6 . ? .	. . . . . . 6 . . .	. . . . 4 . . . . .
—— ramosa, *C. A. Mey.*	. . . . 8 .	0 . . . . . 6 . . 9	. . 2 . . . .
Tozzia alpina, *Linn.*	1 2 3 . . . . 8 .	. . . . . . 6 . . .	. . . . 4 . . . 8 .
Melampyrum cristatum, *Linn.*	1 . . . . . . 8 .	. . . . . . 6 . . 9	. . . . 4 . 6 7 8 9
—— arvense, *Linn.*	1 2 3 4 . 6 7 8 9	. . . . . . 6 . 8 9	. . 2 . 4 5 6 7 8 9
—— nemorosum, *Linn.*	1 2 . 4 5 . . 8 .	. . . .	. . ? 7 8 9
—— pratense, *Linn.*	1 2 . 4 . . 7 8 9	0 1 . 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— sylvaticum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 2 . 4 5 6 7 8 9
Pedicularis rostrata, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (P. Jacquini, *Koch*)	. . . .	. . . .	. . . . . 5 . 7 8 .
—— asplenifolia, *Floerke*?	. . . .	. . . .	. . . . 8 .
—— Portenschlagii, *Saut.*	. . . .	. . . .	. . . . . 5 . . . .
—— fasciculata, *Bell*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5	. 1 2 . 4 . 6 7 8 .
—— tuberosa, *Linn.*	1	0 . . 3 . 5 6 7 8 9	. . 2 3 4 5 6 7 . 9
—— ——, var. (P. sumana, *Pollini*)	. . . .	 9	. . . .
—— Barrelieri, *Reichb.*	. . . .	 9	. 1 2 3 . 5 6 7 . .
—— incarnata, *Jacq.*	1 2 3 4 5 6 . 8 .	. . 2 3 4 5 6 . 8 .	. . . . 4 5 6 7 8 .
—— atrorubens, *Schleich.* (hybrid)	. . . . 8 .	. . . 3 . . 6 . . .	. . . .
—— sylvatica, *Linn.*?	. . . .	. . . . ? .	. . . . 4 . . . . .
—— palustris, *Linn.*	. . . . 8 .	. 1 2 . . . . . ? .	. . 2 . 4 5 6 7 . .
—— comosa, *Linn.*	1 2 . 4 . 6 . 8 .	. . . . . . ? . ? .	. . 2 . 4 . 6 . 8 .
—— foliosa, *Linn.*	1 . . . . . 7 8 .	 9	. . 2 . . . 6 . 8 .
—— ——, var. (P. Hacquetii, *Graf*)	. . . .	. . . .	. . . .
—— recutita, *Linn.*	. . . .	. . 2 3 . 5 6 . . .	. . 2 3 4 5 6 . 8 .
—— rosea, *Linn.*	. 2 3 . 5 6 7 8 9	0 . 2 . 4 . 6 7 8 .	. . . . 7 8 .
—— gyroflexa, *Vill.*	. 2 3 . . 6 7 8 9	. 1 2 . 4 5 6 . ? .	. . 2 . . . . 7 . .
—— versicolor, *Wahlenb.*	. . . . 8 .	. 1	. . . . 8 .
—— acaulis, *Wulf*	. . . .	. . . .	. . . . 4 . 6 7 8 9
—— verticillata, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	. 1 . 3 4 5 6 7 8 9
Rhinanthus major, *Ehrh.*	. 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 . 8 .	0 1 2 . 4 5 6 7 8 9
—— minor, *Ehrh.*	1 2 3 4 5 . 7 8 9	0 . 2 . 4 5 6 7 8 9	0 1 2 3 4 . . 7 8 9
—— ——, var. β, *Reichb.*	1 2	. . . .	. . . . . . 6 . . 9
—— alpinus, *Baumg.? Koch*	. 2 . . . 6 7 . .	. . . . . 5 6 . . 9	. 1 2 3 . 5 6 7 8 9
Bartsia alpina, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
Euphrasia officinalis, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (E. salisburgensis, *Funk*).	1 2 3 4 5 6 . 8 .	. . 2 3 . 5 6 7 8 .	0 1 2 . 4 5 6 7 8 .
—— minima, *Schleich.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9
—— tricuspidata, *Linn.*	. . . .	. . . .	. . . . 8 9
—— Odontites, *Linn.*	1 2 3 4 5 . 7 8 .	. 1 . 3 4 . 6 7 . .	. 1 2 3 4 5 6 7 8 9
—— lutea, *Linn.*	1 2 . . 5 . . 8 9	0 1 . . 4 5 6 . . .	0 . 2 3 4 . 6 7 8 9
—— viscosa, *Linn.*	1 . . . . . 7 8 .	. . . .	. . . .
—— lanceolata, *Gaud.*	1 2 . 4 5 6 7 . 9	0 1 2	. . . .
Lavandula vera, *DC.*	1 2 3 4 . 6 7 8 .	. . . . 4	. . . .
Mentha rotundifolia, *Linn.*	1 2 3 4 . . . 8 9	0 . . . 4 . 6 . . 9	. . 2 . 4 . . 7 8 9
—— sylvestris, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9
—— viridis, *Linn.*	. . . .	. . . . . . 6 . . .	. . . . 4 . . . . .
—— aquatica, *Linn.*	1 2 . 4 . . . 8 9	0 . . . 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9
—— arvensis, *Linn.*	1 . . . . 6 7 8 .	. . . . . . 6 . 8 9	. . . . 4 5 . . . .
—— ——, var. (M. gentilis, *Linn.*)	. . . .	. . . . . . 6 . . .	. . . . 4 9
Pulegium vulgare, *Mill.*	1 2 . . . . . 8 .	. . . . 4 . 6 . . 9	0 . 2 . 4 . 6 . . .
Lycopus europæus, *Linn.*	1 2 . 4 5 6 7 8 9	. . . . 4 . 6 7 8 9	0 1 2 3 4 . 6 . 8 9
—— exaltatus, *Linn. fil.*	. . . .	. . . .	. . . . 8 9
Salvia glutinosa, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Æthiopis, *Linn.*	. 2 . 4 . 6 7 8 .	. . . .	. . . .
—— pratensis, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— clandestina, *Vill.*?	. . . .	. . . .	. . . . . . 6 . 8 9

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . . 7 8 .	0 . . 3	.	F A ? I L C N P S K	Orobanche minor.
. . . .	. . . .	.	F . ?	—— amethystea.
. . . . 7 8 9	. . . .	.	F A ? I . C . P . .	Phelipæa cœrulea.
. . . . 4 5 6 . . 9	0 . . 3	50	. ? G I L C N . . .	—— ramosa.
. . . 3 . . . 7 8 9	. . . 3 . 5 . 7 . .	.	F A G . . . . P . K	Tozzia alpina.
. . 2 . 4 5	0 1 2 3 . . . 7 . .	.	F A G I . C . P . K	Melampyrum cristatum.
0 . 2 . 4 5 6 7 8 9	0 1 . 3 . . . 7 8 .	50	F A G I L C N P S K	—— arvense.
. 1 2 3 4 5 . . 8 9	0 1 2 3 4 5 6 7 . .	.	F A G I L C N ? S K	—— nemorosum.
0 1 . 3 4 5 6 7 8 .	0 1 . 3 4 5 . . 8 .	50	F A G I L C N P S K	—— pratense.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	.	F A G I . . ? P S K	—— sylvaticum.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	50	F A G I . . . P . K	Pedicularis rostrata.
. . . 3 4 5 6 . 8 9	0 . . 3 4 . . 7 . 9	.	. A G I . . . . . K	—— ——, var. (P. Jacquini).
. . . . 7 8 9	. . . . 7 . .	.	. A G . . . . . . K	—— asplenifolia.
. . . 3 . . 6 7 8 .	. . . .	.	. . G	—— Portenschlagii.
. 1 . 3 4 9	. . . 3 4 . 6 . . .	.	F A G . L . ? . . .	—— fasciculata.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P . K	—— tuberosa.
. . . . 4 5 . . . ?	. 1 2 3 4	.	. . . . ? C N . . .	—— ——, var. (P. sumana).
. . 2 . ?	. . . . . ?	.	F A	—— Barrelieri.
. . . . 7 . .	. . . .	.	F A G I . . . . . K	—— incarnata.
. . . .	. . . .	.	. A	—— atrorubens (hybrid).
. . . .	. . . . 4	.	F A G ? . . . P S K	—— sylvatica.
. . . . . 5 . . 8 9	. . 2 3 4 5 . 7 . .	.	F A G ? . . . P S K	—— palustris.
. . . . 4 5	. 1 . 3 4 . 6 . 8 .	.	F . . I L C N P S K	—— comosa.
. . . . 7 8 9	. . . 3 4 . . . 8 .	.	F A G ? L . N P . K	—— foliosa.
. . . . 9	. . . 3	.	. . G I	—— ——, var. (P. Hacquetii).
. . . 3 . 5 6 7 8 9	. . . . 4 5 . 7 . .	.	. A G I . . N . . K	—— recutita.
. . 2 3 . . 6 7 8 9	. . 2 3 4 5 . . . 9	.	F . G ? . . . . . K	—— rosea.
. . . . 4 9	. . . 3	.	F . . . . . N . . .	—— gyroflexa.
. . . . 8 .	. . . .	.	. A G . . . . . ? K	—— versicolor.
. 1 . 3 4	. . ? 9	.	. . . I	—— acaulis.
0 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 . 9	.	F A G I ? C N P S K	—— verticillata.
0 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	Rhinanthus major.
0 1 2 3 . 5 6 7 8 .	0 1 2 3 4 . . 7 8 9	50	F A G I L C N P S K	—— minor.
. . . . 7 8 .	. . . .	.	F . . . . . . P . .	—— ——, var. β.
0 . . 3 4 5 . 7 8 9	. . 2 3 4 5 6 . . .	.	. A G I . . . . S K	—— alpinus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L . . P S K	Bartsia alpina.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Euphrasia officinalis.
. 1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 . 9	.	F A G I L C N P S K	—— ——, var. (E. salisburgensis).
0 . . 3 4 5 6 7 8 9	. . . 3 4 5 . 7 8 9	.	F A G I . . ? P . K	—— minima.
0 1 2 3 4 5 6 . . .	0 1 2 3 4 5 6 . . 9	.	. . . I	—— tricuspidata.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C ? P S K	—— Odontites.
0 1 2 . 4 5 . 7 8 .	0 1 . 3 . . . 7 . .	.	F A G I L C N P . K	—— lutea.
. . . .	. . . .	.	F A . . L . . P . .	—— viscosa.
. . . .	. . . .	.	F	—— lanceolata.
. 1 . . 4 5	0	.	F A . I L C N P . .	Lavandula vera.
. . . . 4 5	0 . . 3 . 5	.	F A . ? L C N P S .	Mentha rotundifolia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P S K	—— sylvestris.
. . . .	. . . 3	50	F A G I ? ? N P S K	—— viridis.
0 . 2 3 4 5 6 7 8 .	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— aquatica.
0 . . 3 4 5 . . 8 9	0 1 . 3 . 5 . 7 8 .	.	F A G I L C N P S K	—— arvensis.
. . . . 7 8 .	0 . . 3	50	F A G . . . . P S K	—— ——, var. (M. gentilis).
. . . . 4 5	0 1 . 3 4 5 . 7 8 .	50	F A G I L C N P . K	Pulegium vulgare.
0 . 2 3 4 . 6 . 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P S K	Lycopus europæus.
. . . . 4	0 1 . 3	.	. . . I L C N . . K	—— exaltatus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C ? P . K	Salvia glutinosa.
. . . .	. . . .	.	F . . I . . . . . K	—— Æthiopis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— pratensis.
. . . .	. . . .	.	. . . I L C N ? . .	—— clandestina.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Salvia verticillata, *Linn.*	. 2 3	. . . .	. . 2 . . 5 6 . . .
Origanum vulgare, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Thymus vulgaris, *Linn.*	1 2	. . . . 4 5	. . . .
—— Serpyllum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (T. pannonicus, *All.*)	1 . 3 4 5 . 7 8 .	0 . 2 . 4 5 6 7 8 9	0 . 2 . 4 5 . 7 8 .
Satureja hortensis, *Linn.*	. . . .	. . . .	. . 2 . . . .
—— montana, *Linn.*	1 2 3 4 5 . . 8 .	. . . .	. . 2 . . . 6 . . .
—— variegata, *Host* (var. S. montanæ?).	. . . .	. . . .	. . . .
—— Piperella, *Benth.*	. 2	. . . .	. . . .
Micromeria græca, *Benth.*	. . . .	. . . .	. . 2 . . . .
Calamintha Acinos, *Clairv.*	1 2 3 4 . . . 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— alpina, *Lam.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— grandiflora, *Moench*	1 2 3 4 5 6 7 8 9	. . . .	. . 2 . 4 . . . 8 9
—— sylvatica, *Bromf.*	. 2 . . . 6 . . .	. . . . . . ? . . 9	0 1 2 . . . 6 . . ?
—— officinalis, *Moench* ?	1 2 3 4 5 6 7 8 9	. . 2 . 4 5 6 7 8 9	0 . 2 . 4 5 6 7 8 .
—— Nepeta, *Clairv.*	1 2 . 4 . 6 7 8 9	0 . . . 4 . 6 . . 9	0 1 2 3 4 5 6 7 8 .
—— thymifolia, *Reichb.*	. . . .	. . . .	. . . .
Clinopodium vulgare, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Melissa officinalis, *Linn.*	. . . . 8 .	. . . 3 . . 6 . . 9	0 . 2 . 4 . . 7 8 .
Horminum pyrenaicum, *Linn.*	. . . .	. . . .	. . 2 . 4 5 6 7 8 9
Hyssopus officinalis, *Linn.*	1 2 . . . . 7 . .	. 1 2 . 4	. . . .
Nepeta Cataria, *Linn.*	. 2 3 4 5 . . 8 9	. . 2 3 4 . 6 . 8 9	. . 2 . 4 5 6 7 8 9
—— Nepetella, *Linn.*	1 2 3 4 5 6 7 8 .	0 . 2 . . 5	. . . .
—— nuda, *Linn.*	1 2 . 4 . . 7 8 .	. 1 9	. . . . . . 6 . . .
Glechoma hederacea, *Linn.*	1 2 . . . . 7 8 9	. . 2 . . . 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Dracocephalum Ruyschiana, *Linn.*	1 . 3 . . . 7 8 .	. . . .	. . . .
—— austriacum, *Linn.*	. . . .	. . . . 4	. . . .
Melittis melissophyllum, *Linn.*	1 2 3 4 . . . 8 9	. . . . . . 6 . 8 9	. . 2 3 4 5 6 7 8 9
Lamium Orvala, *Linn.*	. . . .	. . . .	. . . . ? . . . 8 9
—— amplexicaule, *Linn.*	1 2 . 4 5 . 7 8 9	. . 2 3 4 . 6 . . 9	0 . 2 . 4 5 6 7 8 .
—— purpureum, *Linn.*	1 2 . 4 . . 7 8 9	0 . . . . . 6 . . 9	. . 2 . 4 5 6 7 8 9
—— maculatum, *Linn.*	1 2 3 4 . . 7 8 9	. . . . 4 5 6 . 8 9	. . 2 . 4 5 6 7 8 9
—— longiflorum, *Ten.*	1 2 3	. . . .	. . . .
—— album, *Linn.*	. . . 4 . 6 7 . .	. . . . . . 6 7 . 9	. . 2 3 4 5 6 7 8 9
—— Galeobdolon, *Crantz*	. 2 3 4 . . 7 8 9	0 1 2 . 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9
Galeopsis Ladanum, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 . 4 5 6 . 8 9	0 . 2 . 4 5 6 7 8 .
—— ——, var. (G. intermedia, *Vill.*)	. . 3 . . 6 . 8 .	. 1 . 3	. 1 . . . . . . 8 .
—— glaucovirens, *Reut.*	1 2 3	. . . .	. . . .
—— Tetrahit, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (G. bifida, *Boenn.*)	. . . .	. . . .	. . . . . . 6 7 . .
—— ——, var. parviflora, *Bert.*	. . 3	. . . 3 . . 6 . 8 .	0 1 2 . . . .
—— ——, var. (G. versicolor, *Curt.*)	. 2 3 . . 6 . . .	. . . .	. . 2 . 4 5 . . 8 .
Stachys germanica, *Linn.*	. . . 4 . . 7 8 9	. . . .	 9
—— alpina, *Linn.*	1 2 . . . . . 8 .	. . 2 . 4 5 6 . 8 9	. . 2 3 4 5 6 7 8 9
—— sylvatica, *Linn.*	1 . 3 4 . . 7 8 9	. . 2 . 4 5 6 7 8 9	0 1 2 . 4 . 6 7 8 9
—— palustris, *Linn.*	1 . . . . . . 8 .	. . . .	. . 2 3 4 5 6 . . .
—— arvensis, *Linn.*	1	. . . . 8 .	. . . . 4 5 . . . .
—— annua, *Linn.*	1 2 . . . . . 8 .	 9	. . 2 . . . .
—— recta, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— labiosa, *Bert.*	. . . .	. . . .	. . . . . . 6 7 . .
Betonica officinalis, *Linn.*	1 2 3 . . . 7 8 9	. . . . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— hirsuta, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 . . 9	. . 2 . 4 . 6 7 8 9
—— Alopecurus, *Linn.*	. . . .	. . . .	. . 2 . 4 . 6 7 8 9
Sideritis scordioides, *Linn.*	1 2	. . . .	. . . . ? . .
—— montana, *Linn.*	. . . .	. . . . ?	. . 2 . . . .
—— romana, *Linn.*	? 2	. . . .	. . . .
Marrubium vulgare, *Linn.*	1 2 3 4 . . 7 8 .	0 . 2 3 4 5 . . . 9	. . 2 . 4 5 6 7 8 .

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . . 4 5 6 . 8 9	0 1 2 3 4 5 . 7 . .	50	. A G I L C ? . . K	Salvia verticillata.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Origanum vulgare.
. . . .	. . . .	.	F . . I L C N P . .	Thymus vulgaris.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Serpyllum.
0 1 2 . 4 5 6 7 8 .	0 1 2 3 4 . . 7 . 9	.	? A G I L C N ? . K	—— ——, var. (T. pannonicus).
. 1 . . 4	0 . . 3 . . . 7 8 9	.	F . . I L C ? ? . .	Satureja hortensis.
0 1 . 3 4 5	0 1 2 3 4 5 6 7 8 9	50	F . . I L C ? P . ?	—— montana.
. . . .	. . . .	50	. . . I	—— variegata (var. S. montanæ ?).
. . . .	. . . .	.	. . . ? L	—— Piperella.
. . . .	. . . .	.	. . : I L C N . . .	Micromeria græca.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P S K	Calamintha Acinos.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— alpina.
0 1 2 3 4 5 6 . . 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P . K	—— grandiflora.
. . . .	. . . .	.	? ? . ? . C N . . ?	—— sylvatica.
. . 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 8 9	.	F A G I L C N P . K	—— officinalis.
0 1 2 . 4 5 6 . 8 .	0 1 2 3 4 5 . 7 . .	.	F A G I L C N P . K	—— Nepeta.
. . . .	. . . . 7 . 9	50	. . . I	—— thymifolia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Clinopodium vulgare.
0 1 . . 4 5 6 7 8 .	0 1 . 3	.	. . . I L C N . . .	Melissa officinalis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	. A G I . C . P . .	Horminum pyrenaicum.
. . . . 4	. . . . 4 . 6 7 . .	.	F A G I L C N P . K	Hyssopus officinalis.
. 1 . 3 4 5 . 7 8 9	0 1 . 3 4 5 . 7 8 .	.	F A G I L C N P S K	Nepeta Cataria.
. . . .	. . . .	.	F A . . L . N P . .	—— Nepetella.
. 1 . . 4	0 . . 3 4 . . 7 . .	.	F A G I . . N P . K	—— nuda.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Glechoma hederacea.
. . . . 7 . .	. . . .	.	F A ? . . . . P . K	Dracocephalum Ruyschiana.
. . . . 7 . .	. . . .	.	F A . . . . . P . K	—— austriacum.
0 1 2 3 4 5 . . 8 .	0 1 2 3 . . . 7 8 9	50	F A G I L C N P . K	Melittis melissophyllum.
0 1 2 3 4 5	0 1 2 3 4 . . 7 8 9	50	. . G I . . . . . K	Lamium Orvala.
. . 2 3 4 5 . . 8 9	0 1 . 3 . 5 . 7 . .	.	F A G I L C N P S K	—— amplexicaule.
0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5	.	F A G I L C ? P S K	—— purpureum.
0 1 2 3 4 5 . . 8 .	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— maculatum.
. . . .	. . . .	.	F . . . L . N . . .	—— longiflorum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I . . . P S K	—— album.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Galeobdolon.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P S K	Galeopsis Ladanum.
. . . . . 5 . 7 8 9	. . . .	.	F . . . . . N P . .	—— ——, var. (G. intermedia).
. . . .	. . . .	.	. . . . . C . P . .	—— glaucovirens.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Tetrahit.
. . . . 8 .	. . . .	.	. A G . . . . . S K	—— ——, var. (G. bifida).
. . . . 4 5 . . . 9	. 1 2 3 . 5	.	. . . . L C N ? ? ?	—— ——, var. parviflora.
. . 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 . .	.	? A G . L C N . S K	—— ——, var. (G. versicolor).
. . 2 . 4 5 6 7 . .	0 1 . 3 4	.	F A G I L C N P . K	Stachys germanica.
0 . 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C . P . K	—— alpina.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	.	F A G I L C N P S K	—— sylvatica.
. . 2 . 4 5 6 7 8 9	0 1 . 3 4 5 . 7 . .	.	F A G I ? C N P S .	—— palustris.
. . . .	. . . .	.	F A G I L C N P S K	—— arvensis.
. . . . 4 5 6 . 8 9	0 . 2 3 . . . 7 . .	.	F A ? I L C N P S K	—— annua.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— recta.
. . . .	. . . .	.	. . . I . C N . . .	—— labiosa.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 .	.	F A G I L C N P S K	Betonica officinalis.
0 . . 3 4 . 6 . . 9	. . . 3 . . . 7 . .	.	F A . ? L C N P . K	—— hirsuta.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F . G I . C N P . K	—— Alopecurus.
. . . .	. . . .	.	. A . . L . . P . .	Sideritis scordioides.
. . . .	. . . .	.	. . . I ? C N . . K	—— montana.
. . . .	0	.	. . . I L C ? . . .	—— romana.
. . . . 4 5 . 7 8 9	0 1 . 3 . 5 . 7 8 .	.	F A G I L C N P S K	Marrubium vulgare.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Marrubium candidissimum, *Linn.*	. . . .	. . . .	. . . .
Ballota nigra, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9
—— spinosa, *Link*	1 2	. . . .	. . . .
Leonurus Cardiaca, *Linn.*	1 . . . . . . 8 9	. . 2 . . . 6 . . 9	. . 2 . 4 . 6 7 8 .
Chaiturus Marrubiastrum, *Reichb.*	 9	. . . .	. . . .
Scutellaria alpina, *Linn.*	1 2 . 4 5 6 7 8 .	0 1 2 3 4 5 6 . 8 .	. . . . 4 . . . . .
—— minor, *Linn.*	. . . .	 9	. . . .
—— galericulata, *Linn.*	. 2 . . . 6 . 8 .	. . . . . . 6 . . 9	0 . 2 . 4 . 6 7 . 9
—— hastifolia, *Linn.*	. . . . 8 .	. . . .	. . . .
Prunella vulgaris, *Linn.*	1 2 3 4 5 6 7 8 9	0 . 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— grandiflora, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 . 2 3 4 5 6 7 8 9
—— alba, *Pall.*	1 2 3 4 5 . . 8 9	. . . . 4 5 6 . . .	. . 2 . 4 . 6 . 8 .
—— hyssopifolia, *Linn.*	1 2	. . . .	. . . .
Ajuga reptans, *Linn.*	1 2 3 4 . . 7 8 9	. . . . 4 . 6 . 8 9	0 . 2 3 4 5 6 7 8 .
—— genevensis, *Linn.*	1 2 3 4 5 6 . 8 9	. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— pyramidalis, *Linn.*	1 2 3 4 . . 7 8 9	0 1 . . . 5 6 7 8 9	0 . 2 . 4 5 6 7 8 9
—— Chamæpitys, *Linn.*	1 2 . 4 . . . 8 9	. 1 2 . 4 . 6 . . .	. . 2 . . . 6 7 . 9
Teucrium Scorodonia, *Linn.*	1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9
—— Botrys, *Linn.*	1 2 3 4 5 6 7 8 .	0	. . . . 7 8 .
—— Scordium, *Linn.*	. . . . 8 .	. . . . 4	. . 2 . . . 6 . . .
—— lucidum, *Linn.*	1 2 . 4	. . . .	. . . .
—— Chamædrys, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— flavum, *Linn.*	? ?	. . . .	. . . .
—— Polium, *Linn.*	1	. . . .	. . . .
—— montanum, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Verbena officinalis, *Linn.*	1 2 3 4 . 6 7 8 9	0 . 2 . 4 . 6 . 8 9	0 1 2 3 4 5 6 7 8 .
Pinguicula alpina, *Linn.*	1 2 . . 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	0 . 2 . 4 . 6 7 8 .
—— vulgaris, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— grandiflora, *Linn.*?	. 2 3 . 5	. . . . . 5	? . 2 . . . 6 . 8 .
Utricularia vulgaris, *Linn.*	. . . . 8 .	 9	. . 2 . 4 . 6 . . .
—— Bremii, *Heer*	. . . .	. . . .	. . 2 . 4 . 6 . . .
—— minor, *Linn.*	. . . .	. . . .	. . 2 . . . .
Trientalis europæa, *Linn.*	. . . .	. . . .	. . . .
Lysimachia vulgaris, *Linn.*	1 . 3 . 5 6 7 8 9	. . . . . . 6 . . 9	0 1 2 . 4 5 6 7 8 9
—— punctata, *Linn.*	. . . .	. . . .	. . . .
—— Nummularia, *Linn.*	. 2 3 . . 6 . 8 9	. . . . . . 6 7 8 9	. . 2 . 4 . 6 7 8 9
—— nemorum, *Linn.*	. . . . . . 7 8 9	. . . . . . 6 . . 9	. . 2 . . . . 7 8 .
—— Linum-stellatum, *Linn.*	1 . . . . . . 8 .	. . . .	. . . .
Coris monspeliensis, *Linn.*	1 2	. . . .	. . . .
Anagallis arvensis, *Linn.*	1 2 3 4 . . 7 8 9	. 1 2 3 4 . 6 . . 9	0 . 2 . 4 5 6 7 8 .
—— ——, var. (A. cærulea, *Lam.*)	1 2 . . . . . 8 9	. . . .	. . . . 4 . . 7 8 .
—— tenella, *Linn.*	. 2	 9	. . . .
Centunculus minimus, *Linn.*	. . . . . 6 . . .	. . . .	0 . 2 . . . .
Androsace helvetica, *Gaud. et ? Linn.*	. . . . 5	. . . . . . 6 ? ? .	. . 2 . . 5 . 7 . .
—— argentea, *Gærtn.*	1 2 . . 5 . . . 9	. . 2 . . 5 6 7 8 9	. . . . . 5 6 7 8 .
—— Charpentieri, *Heer*	. . . .	. . . .	. . 2 . 4 . 6 7 . .
—— Hausmanni, *Leyb.*	. . . .	. . . .	. . . .
—— glacialis, *Hoppe*	1 . 3 . 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 . 8 .
—— villosa, *Linn.*	1 2 . . . 6 7 8 .	. . . . 8 .	. . . . . 5 6 . 8 .
—— Chamæjasme, *Host*	. . . . 8 .	. . . .	. . 2 3 4 . 6 7 8 .
—— obtusifolia, *All.*	1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	. . 2 3 4 5 6 . 8 .
—— lactea, *Linn.*	. . . .	. . . . . ?	. . . . 4 . . . . .
—— carnea, *Linn.*	1 2 3 4 5 6 7 8 9	. . 2 . 4 5 6 . . .	. . 2 . . 5 6 . 8 .
—— maxima, *Linn.*	1 . . . . 6 7 8 .	. . . .	. . . . 4 . . . . .
Aretia Vitaliana, *Linn.*	1 2 . . 5 6 7 8 9	0 . . . . 5 . 7 8 .	. . . . 4 5 6 . 8 .
Primula farinosa, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 8 .
—— longiflora, *All.*	. . . 4 5	. . . .	. 1 . . 4 5 . . 8 .
—— acaulis, *Jacq.*	1 2 . . . . . 8 9	. . . .	. . 2 . 4 5 6 7 8 .
—— elatior, *Jacq.*	. 2	. . . . ? . .	. . 2 . 4 5 6 7 8 9
—— officinalis, *Jacq.*	. 2 3 4 . . . 8 .	. . 2 . 4 . 6 . . 9	. . 2 . 4 . 6 7 8 9

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . .	. . . . 8 .	.	. . . I . C N . . .	Marrubium candidissimum.
. . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P S K	Ballota nigra.
. . . .	. . . .	.	F	—— spinosa.
. . . . 4 5 6 7 8 9	0 1 . 3 . . . 7 . .	50	F A G I L C ? P S K	Leonurus Cardiaca.
. . . . 4	. . . .	.	. . G I . C . . . K	Chaiturus Marrubiastrum.
. . . .	. . . .	50	F A . I L . . P . K	Scutellaria alpina.
. . . .	. . . .	.	. . . . K	—— minor.
0 . 2 . 4 5 . 7 . 9	0 . . 3 . . . 7 . .	50	F A G I L C . P S K	—— galericulata.
. . . .	. . . .	.	. A . . . C . . S K	—— hastifolia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P S K	Prunella vulgaris.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	50	F A G I L . . P S K	—— grandiflora.
. 1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	.	F A . I L C N P . K	—— alba.
. . . .	. . . .	.	F . . . L	—— hyssopifolia.
0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	Ajuga reptans.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— genevensis.
0 . 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 8 9	.	F A G I L . . P S K	—— pyramidalis.
. . 2 . 4 5 . 7 8 .	0 1 . 3 . . . 7 . .	.	F A G I L C N P . K	—— Chamæpitys.
0 . . . 4	0 1	.	F A ? I L C N P S .	Teucrium Scorodonia.
. . 2 3 4 5	0 . . 3 4 5 . 7 . .	.	F A G I L C N P . .	—— Botrys.
. . . . . 5	. . . 3	.	F A ? I L C N P S K	—— Scordium.
. . . .	. . . .	.	F . . . L	—— lucidum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— Chamædrys.
. . . .	. . . .	50	. . . I L C N . . .	—— flavum.
. . . .	. . . .	.	. . . I L C N . . .	—— Polium.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— montanum.
0 1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P S K	Verbena officinalis.
0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 . 9	50	F A G I . . . P S K	Pinguicula alpina.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 .	50	F A G I L C N P S K	—— vulgaris.
. . . 3 4 . . 7 8 9	. . 2 3 4 . 6 . . .	.	F A . . L C N P . ?	—— grandiflora.
. . . . . 5 . . 8 .	. . 2	50	? A G I . C . ? S K	Utricularia vulgaris.
. . . . . 5	. . . .	.	. A G . . . . . S .	—— Bremii.
. . . . . 5 . . 8 .	. . . 3	.	? A G . . . . ? S K	—— minor.
. . . 3 . . . 7 . ?	. . . . 7 . .	.	. A . . . . . . S K	Trientalis europæa.
. . 2 3 4 5 6 7 8 9	0 1 . 3 4 . . 7 8 .	50	F A G I L C N P S K	Lysimachia vulgaris.
. . . .	. . . .	50	. ? G I L C . . . K	—— punctata.
0 . . . 4 5	0 1 . 3 4 . . 7 . .	50	F A G I L C N P S K	—— Nummularia.
. . . . ? .	. . . .	.	F A G I L C N P S K	—— nemorum.
. . . .	. . . .	.	. . . I L C N . . .	—— Linum-stellatum.
. . . .	. . . .	.	. . . . L	Coris monspeliensis.
0 1 2 3 4 5 . 7 8 .	0 1 2 3 . . 6 7 8 .	.	F A G I L C N P S K	Anagallis arvensis.
. 1 2 . 4 5 6 . . .	0 1 . 3 4	50	F A . I L C N P S K	—— ——, var. (A. cærulea).
. . . . 4	0 . . . . . . 7 . .	.	. A G . L C . ? . .	—— tenella.
. . . . 8 .	. . . .	.	? A G I L C . P S K	Centunculus minimus.
. . . 3 ? 5 6 . 8 9	. . . 3	.	F A G . . . . . . ?	Androsace helvetica.
. . . . 4 . ? . . .	. . . 3	.	F A . . . . . P . .	—— argentea.
. . . .	. . . .	.	. . ? ?	—— Charpentieri.
. . 2 . . . . . 8 9	. 1 . . . 5	.	. . G	—— Hausmanni.
. . . 3 ? . 6 7 8 9	. . . 3 4 5 . . . 9	50	. A G I	—— glacialis.
. . . .	. . . 3 4 . 6 7 . 9	.	F A ? I . C N P . K	—— villosa.
. . . . 4 . . . . ?	. . . . . . 6 . . .	.	. A G . . . . . S K	—— Chamæjasme.
. 1 2 3 4 5 . 7 8 9	0 . . 3 4 9	.	F A G I L . . . . K	—— obtusifolia.
. . . . 4	0 . . . ?	.	F A G I . . . . . K	—— lactea.
. . . . ? 8 .	. . . .	.	F A ? . L . . P . .	—— carnea.
. . . . ? .	. . . .	.	F A . . . . . P . K	—— maxima.
. . . . 4 5 . . 8 9	. . . 3 4	.	F A . . L . N P . .	Aretia Vitaliana.
. . . 3 4 5 . 7 8 9	. 1 . 3 4 5 . 7 . .	.	F A G I . . . P S K	Primula farinosa.
. 1 . 3 . . 6 7 8 9	. . 2 3 4 5 . . . 9	.	F A G I . . . . . K	—— longiflora.
. . . 3 4 5 6 . . .	0 1 . 3	50	F A G I L C N ? S K	—— acaulis.
0 . 2 3 4 5 6 . 8 .	. ? 2 3 4 . . 7 . .	50	F A G I L . . ? S K	—— elatior.
. . . 3 4 5 6 . 8 9	0 1 . 3 4 . 6 . . .	.	F A G I . . N P S K	—— officinalis.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Primula officinalis, var. (P. suaveolens, *Bert.*).	1 2	. . . .	. . . .
—— Auricula, *Linn.*	. . 3 4 5	. . . . . . 6 7 8 9	. . 2 . 4 . 6 7 8 9
—— ——, var. (P. ciliata, *Moretti*)	. . . .	. . . .	. . 2 . . . .
—— venusta, *Host* (hybr. ?)	. . . .	. . . .	. . . .
—— marginata, *Curt.*	1 2 3 4 5 6 . . .	. . . . . . ? ? . .	. . . .
—— carniolica, *Jacq.*	. . . .	. . . .	. . . .
—— rhætica, *Gaud.*	. . . .	. . . .	. ? . . 4 . . 7 . .
—— pedemontana, *Thom.*	. 2 3 . . 6 7 8 9	. . 2 . . . 6 . 8 .	. . . .
—— villosa, *Jacq.*	1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. glandulosa, *Duby*	1 . 3 . . . . 8 .	. . . 3	. . . . . 5 . . . .
—— ——, var. pygmæa, *Ball*	. . . .	. . . . 8 .	. . . 3 4 . . . . .
—— ——, var. (P. latifolia, *Lapeyr.*).	1 2 3 4 5	. . . . . 5 6 . 8 .	0 . . . 4 . 6 7 ? .
—— Allionii, *Lois.*	1 2 3	. . . .	. . . .
—— tyrolensis, *Schott*	. . . .	. . . .	. . . .
—— œnensis, *Thom.*	. . . .	. . . .	. . . . . 5 . . . 9
—— spectabilis, *Tratt.*	. . . .	. . . .	. . ? . . . .
—— calycina, *Duby*	. . . .	. . . .	. . 2 . . 5 6 7 8 9
—— integrifolia, *Linn.* ?	. . 3	. . . .	. 1 . 3 4 5 . . 8 .
—— glutinosa, *Wulf.*	. . . .	. . . .	. . . . . 5 . . 8 .
—— Facchinii, *Schott* (hybr. ?)	. . . .	. . . .	. . . .
—— minima, *Linn.*	. . . .	. . . .	. . . . 4 5 . . 8 .
Hottonia palustris, *Linn.*	. . . .	 9	. . 2 . . . 6 . . .
Cortusa Matthioli, *Linn.*	. . . . . 6 7 8 .	. . . .	. . . .
Soldanella alpina, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— pusilla, *Baumg.*	. . . .	. . . .	. . . . 4 5 . 7 8 9
Cyclamen europæum, *Linn.*	. . . . 8 9	0 . . . . . 6 7 8 9	0 1 2 3 4 . 6 7 8 9
Samolus Valerandi, *Linn.*	1 2 3 . . . . 8 9	. . . . 4	. . . .
Globularia vulgaris, *Linn*	1 2 3 4 . 6 7 8 .	. 1 . . . 5 6 . . 9	0 . 2 . 4 . 6 7 8 9
—— nudicaulis, *Linn.*	1 2 . . . 6 . 8 9	. . . .	. . 2 . 4 5 6 7 8 9
—— cordifolia, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Armeria alpina, *Willd.*	1 2 3 4 5 6 . 8 9	0 1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .
—— plantaginea, *Willd.* ?	. . . . 8 9	. . 2 . . 5 6 7 8 .	. . . .
—— ——, var. brachylepis, *Boiss.*	1 2 3	. . . . . 5	. . . .
Littorella lacustris, *Linn.*	. . . .	. . . . . . 6 . . .	. . . . 4 . 6 . 8 .
Plantago major, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— media, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— lanceolata, *Linn.*	1 2 3 4 . 6 7 8 9	0 1 . 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (P. altissima, *Linn.*)	. . 3	. . . .	. . . .
—— argentea, *Chaix*	. 2 . . . . . 8 .	. . . . . . ? . . ?	. . . . . . 6 . . .
—— Lagopus, *Linn.*	1 2	. . . .	. . . .
—— montana, *Lam.*	1 . . . . . 7 8 9	0 1 2 . . . . . 8 .	. . . . . . 6 . 8 .
—— fuscescens, *Jord.*	1 2 . . 5 . . ? .	. . . .	. . . .
—— serpentina, *Lam.*	1 2 . 4 . . 7 8 9	. . . . 4 9	. . . . . 5 . . 8 .
—— alpina, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— Coronopus, *Linn.*	1 2	. . . . . . 6 . . .	. . . .
—— arenaria, *Waldst. & Kit.*	. . . . 8 .	. . . . 4 . 6 . . .	. . 2 9
—— Cynops, *Linn.*	1 2 3 4 . . 7 8 9	. . . . 4 . 6 . . .	. . . . 7 8 .
Amaranthus Blitum, *Linn.*	1 2 . . . . . 8 9	. . 2 . 4 5 6 . . 9	. . 2 . . . 6 7 8 .
—— ——, var. (A. adscendens, *Lois.*)	. . . .	. . . .	. . 2 . . . 6 . . .
—— prostratus, *Balb.*	. . . .	. . . . 4	. . . 3 9
—— retroflexus, *Linn.*	1 2 . . . . . 8 .	. . . .	. . 2 ? . . . 7 8 .
—— patulus, *Bert.*	1 2 9	. . . . 4 . 6 . . .	. . 2 3 4 . 6 . . .
Phytolacca decandra, *Linn.*	. . . .	. . . . . . 6 . 8 9	0 1 2 3 4 . 6 7 8 .
Polycnemum arvense, *Linn.*	. . . 4 . . . 8 .	. . . 3 4 . 6 . . .	. . 2 . . . . 7 8 .
Kochia scoparia, *Schrad.*	. . . .	. . . .	. . 2 . . . . 7 8 .
—— prostrata, *Schrad.*	. . . .	. 1 . 3 4	. . . .
Chenopodium hybridum, *Linn.*	. . . . 8 9	. 1 2 . . 5 6 . . .	. . 2 3 4 . . 7 8 .

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . . 4	. ?	.	. . . I L C N P . .	Primula officinalis, var. (P. suaveolens).
0 1 2 3 4 5	0 1 . 3 . 5 6 7 . .	.	F A G I . C N ? . K	—— Auricula.
. . . 3 4 . 6 7 . 9	. 1 2 3 4	.	. . . .	—— ——, var. (P. ciliata).
. . . . 4	. ?	50	. . . .	—— venusta.
. . . .	. . . .	.	F . . . L	—— marginata.
. . . . ?	. . . ?	50	. . . I	—— carniolica.
. . . .	. . . .	.	. A G	—— rhætica.
. . . .	. . . .	.	F A	—— pedemontana.
. . 2 3 . 5 6 7 8 9	. . 2 3 4 5	.	F A G I L . . P . .	—— villosa.
. . . .	. . . .	.	. . . .	—— ——, var. glandulosa.
. . . . 4 . . . 8 9	. . 2 . 4	.	. A	—— ——, var. pygmæa.
. . . .	. . . .	.	F A . . L . . P . .	—— ——, var. (P. latifolia).
. . . .	. . . .	.	. . . .	—— Allionii.
. . . . 9	. . . 3 4 5 6 . . .	.	. . . .	—— tyrolensis.
0 . . 3 . . 6 . . .	. . . .	.	. A	—— œnensis.
0 1 2 3 4 5 6 . . 9	0 1 2 3 . . 6 . . .	.	. . G I	—— spectabilis.
0 . 2	. . . .	.	. . . .	—— calycina.
. . . .	. . . .	.	. A . . . . . P . .	—— integrifolia.
. . . 3 . . 6 7 8 9	. . . 3 4	.	. . G	—— glutinosa.
. . . 3 . . . . ? ?	. . . .	.	. . G	—— Facchinii (hybr. ?).
0 . . 3 . . . 7 8 9	. . . 3 4 5 . 7 . 9	.	. A G I	—— minima.
. . . 3	0 . . . . . . 7 . .	.	? A G I ? C N ? S K	Hottonia palustris.
. . . . . ? . 7 . .	. . . 3 4 . 6 . . .	.	F A G I . . . . S K	Cortusa Matthioli.
. . . 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 . .	.	F A G I L C N P . K	Soldanella alpina.
0 . 2 3 . . 6 7 8 9	. 1 2 3 4 5 6 7 . .	.	. A G I . . . . . K	—— pusilla.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I ? . . . . K	Cyclamen europæum.
. 1 2 . 4 5 . . 8 .	0	.	F A G I L C N P S ?	Samolus Valerandi.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	Globularia vulgaris.
. 1 . 3 4 5 6 . 8 9	0 1 2 3 . 5 . 7 . .	.	F A G I . . . P . .	—— nudicaulis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— cordifolia.
. . 2 3 4 5 6 7 8 9	. 1 . 3 4 5 . 7 . 9	.	F A G I L C N P S K	Armeria alpina.
. . . .	. . . .	.	F A . I L C N P . .	—— plantaginea.
. . . .	. . . .	.	. . . .	—— ——, var. brachylepis.
. . . . 4	. . . .	.	F A G . . . . P S K	Littorella lacustris.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	Plantago major.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— media.
0 1 . 3 4 5 6 . . 9	0 1 2 3 4 5 . 7 . 9	50	F A G I L C N P S K	—— lanceolata.
0 1 . . 4 5 . . 8 9	. . . .	.	. . . I . . . . . K	—— ——, var. (P. altissima).
. 1 . . 4 5 . . . 9	0 1 . 3 . . . 7 . .	.	F . . I L C N . . K	—— argentea.
. . . .	. . . .	.	. . . I L ? N . . .	—— Lagopus.
. 1 2 . 4 5 . . 8 9	0 1 2 3 4 . . 7 . 9	.	F A G I L C N P . K	—— montana.
. . . .	. . . .	.	F	—— fuscescens.
0 1 2 . 4 5 . 7 8 9	0 1 . 3 4 5 6 7 . 9	50	F . . I L C N . . K	—— serpentina.
. . 2 . 4 5 . 7 . 9	. 1 . 3	50	F A G ? L ? N P S K	—— alpina.
. . . .	. . . .	.	? . . ? L C N P S .	—— Coronopus.
. . . . 4 5 6 7 8 .	0 1 . 3	.	F . . ? L C N P . K	—— arenaria.
. . . .	. . . .	.	F A . ? L C N P . K	—— Cynops.
. . . . 4 5 6 7 8 9	0 . . 3	.	F A ? I L C N P S K	Amaranthus Blitum.
. . . . 4 5 6 . . .	0 . . 3	.	. . . . L C N . . .	—— ——, var. (A. adscendens).
. . . .	. . . .	.	. . G I L C N . . K	—— prostratus.
0 . . 3 4 5 6 7 8 9	0 . . 3	.	F A . I L C N P . K	—— retroflexus.
. ? . . 4 5 . . 8 .	0 . . 3 . . . 7 . .	.	. . . I L C N . . .	—— patulus.
. . . . 4 5 . 7 8 .	0 1 . 3	.	. . . I L C N P . .	Phytolacca decandra.
. . 2 . 4 . . . 8 9	0	.	. A ? I L C N P . K	Polycnemum arvense.
. . . . 4	. . . .	50	. . G I L C . . . K	Kochia scoparia.
. . . .	. . . .	.	. . . . P . K	—— prostrata.
. . . 3 . 5 . 7 8 9	0 . . . . . . 7 . .	50	F A G I ? C N P S K	Chenopodium hybridum.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Chenopodium urbicum, *Linn.*	. . . .	. 1 2	. . . . . 5 . 7 8 .
—— album, *Linn.*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— opulifolium, *Linn.*	1 2	. . . .	. . 2 . . . . 7 . .
—— ambrosioides, *Linn.* (spont.?)	. . . .	. . . .	. . . .
—— murale, *Linn.*	1 2 . . . 6 . 8 .	. 1 2 3 4	. . 2 3 4 5 6 7 . .
—— polyspermum, *Linn.*	. . . . . 6 . 8 9	. . 2 . . . 6 . . .	. . 2 . . . 6 7 . .
—— Vulvaria, *Linn.*	1 2 . . 5 . 7 8 9	. . 2 . 4 5 6 . . 9	. . 2 . . . 6 7 8 .
—— Botrys, *Linn.*	. . . . 8 .	. . 2 . 4 5	. . 2 3 . . 6 7 8 .
Blitum capitatum, *Linn.*	. . . .	. . . . 4	. . 2 . . . .
—— virgatum, *Linn.*	. . . .	. . . .	. . 2 . . 5 . . . .
—— Bonus-Henricus, *C. A. Mey.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— rubrum, *Reichb.*	. . . 4 . 6 . 8 9	. . . . . . 6 . . 9	. . . .
—— glaucum, *Koch*	. . . . 8 .	. . . . . . 6 . . .	. . . .
Atriplex patula, *Linn.*	1 2 . 4 . 6 . 8 9	. . . 3 4 5 6 . . 9	. . 2 . 4 5 6 7 8 9
—— hastata, *Linn.*	1 2	. . . . . . 6 . . 9	. . . . 7 8 .
Rumex conglomeratus, *Murr.*	1 2 . 4 5 . 7 8 9	. . . . 4 5 6 . 8 9	0 . 2 . 4 . 6 7 8 .
—— sanguineus, *Linn.*	1 2 . 4	. . . . . 5 6 . . 9	. . . . 4 . . 7 8 .
—— bucephalophorus, *Linn.*	. . . .	. . . . 4	. . . .
—— pulcher, *Linn.*	1 2 . . . 6 7 8 9	. . . . 4 . . . 8 9	. 1 2 3 4 5 6 7 8 9
—— obtusifolius, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 .
—— Patientia, *Linn.*	. . . . . ? . . 9	. . . . . . ? . . .	. . . . 4 . . . . .
—— pratensis, *Mert. & Koch*?	. . . .	. . . .	. . . .
—— crispus, *Linn.*	. . . 4 . 6 . . .	. . . .	. . 2 3 . . 6 7 8 .
—— Hydrolapathum, *Huds.*	. . . .	. . . . 4	0 . 2 . 4 . 6 . . .
—— aquaticus, *Linn.*	. . . .	. . . .	. . . . . 5 . . . .
—— alpinus, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— scutatus, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— tuberosus, *Linn.*	. . . .	. . . .	. . . .
—— arifolius, *All.*	1 2 3 4 . 6 . 8 9	0 . 2 3 . 5 6 7 8 9	. 1 . . . 5 . 7 8 .
—— Acetosa, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9
—— Acetosella, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (R. acetoselloides, *Bal.*)	. 2	. . . .	. . . .
Oxyria digyna, *Campd.*	1 . 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .
Polygonum Bistorta, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— viviparum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— amphibium, *Linn.*	. . . . 5 . . 8 .	 9	. . 2 . . . .
—— lapathifolium, *Linn.*	. . . .	. . . . . . 6 . 8 .	0 . 2 3 4 5 6 7 8 .
—— Persicaria, *Linn.*	. . . 4 . . 7 8 9	0 . 2 3 4 5 6 . 8 9	0 1 2 3 4 . 6 7 8 9
—— mite, *Schrank*	. . . .	. . . . 4 . 6 . 8 .	. . 2 . . . . . 8 .
—— Hydropiper, *Linn.*	1 2 3 . . 6 7 8 9	0 . . 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— minus, *Huds.*	. . . .	. . . . . . 6 . . 9	. . . .
—— aviculare, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (P. Bellardi, *All.*)	. . . . . 6 . . .	. . . . . . 6 . . 9	 9
—— Convolvulus, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— dumetorum, *Linn.*	. 2 3 . . 6 . . .	. . . . 4 . 6 7 8 9	0 1 2 3 4 . . 7 8 .
—— alpinum, *All.*	1 2 . 4 5 6 . 8 .	0 . . . . . 6 7 8 9	0 1 . 3 . 5 6 7 8 .
Passerina annua, *Wickstr.*	. 2 . . . . . 8 .	 9	. . 2 . 4 . . 7 8 .
Daphne Mezereum, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Laureola, *Linn.*	1 2 . . . . 7 8 .	. . . . . . 6 . . 9	. . 2 . 4 . 6 7 8 .
—— alpina, *Linn.*	1 2 . . . 6 7 8 9	. . . . . . 6 . 8 .	. . . . . 5 . 7 8 9
—— Cneorum, *Linn.*?	1 2 9	. . . . 4 . . . . ?	0 . 2 3 4 . 6 7 8 .
—— striata, *Tratt.*	. . . .	. . . .	. . . . 4 5 6 7 8 9
—— rupestris, *Facch.*	. . . .	. . . .	 9
Thymelæa dioica, *All.*	1 2	. . . .	. . . .
Thesium montanum, *Ehrh.*	. 2 . 4	. . 2	. . 2 . 4 . 6 7 . 9
—— intermedium, *Schrad.*	. . . 4 . . . 8 .	. . . . . . 6 . 8 9	0 1 2 . 4 5 6 7 8 9
—— pratense, *Ehrh.*	. . . .	. . . .	. . . . 7 8 .
—— alpinum, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	. . 2 . 4 5 6 7 8 9
—— rostratum, *Mert. & Koch*	. . . .	. . . .	. . . .

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . 2 . . 5 6 . 8 .	. . . . 7 . .	.	? A G I L C N ? S K	Chenopodium urbicum.
0 1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P S K	—— album.
. . . . 4 5	0	.	? ? ? I L C N P S K	—— opulifolium.
. . . .	0 . . . . 8 .	.	. . G I L C N P . K	—— ambrosioides (spont.?).
. . . . 4 5 . 7 8 .	0 . . . . . . 7 . .	.	F A G I L C N P S K	—— murale.
0 . 2 . . 5 6 7 8 9	0 . . 3 . . . 7 8 .	50	? A G I L C N P S K	—— polyspermum.
. . 2 . 4 5 . . 8 9	0 1 . 3 4 . . 7 8 9	50	F A G I L C N P S K	—— Vulvaria.
. . . . 4 5 . 7 8 9	0	50	F A G I L C N P . K	—— Botrys.
. . . . . . ? 7 . .	. . . .	50	? A . I . . . ? S K	Blitum capitatum.
. . . . . 5 6 7 8 9	. . . .	.	F A G I . . . P S K	—— virgatum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P S K	—— Bonus-Henricus.
. . . . . 5 . 7 8 .	. . . . 7 . .	.	? A ? I . C . ? S K	—— rubrum.
. . . . . 5 . 7 8 9	. . . . 7 . .	50	. A ? I . . . . S K	—— glaucum.
0 . . . 4 5 6 7 8 .	0 1 2 3 4 5 . 7 . .	50	F A G I L C N P S K	Atriplex patula.
? . . . 4 5 6 . . .	0 1 . 3 . . . 7 . .	50	F A G I L C N P S K	—— hastata.
. . 2 . 4 5 6 7 8 .	0 1 . 3 4	.	F A G I L C N P S K	Rumex conglomeratus.
. . . .	. . . . 4 . . 7 8 .	.	F A G I L . . P S K	—— sanguineus.
. . . .	. . . .	.	. . . I L . N ? . .	—— bucephalophorus.
0 1 2 . 4 5 . 7 8 .	0 1 2 3 . 5 . 7 8 .	50	F A ? I L C N P . K	—— pulcher.
0 1 2 . 4 5 . . 8 9	0 1 . 3 4 5 . . 8 .	.	F A G I L C N P S K	—— obtusifolius.
. . . . 9	. . . .	.	. . ? I . C . . . ?	—— Patientia.
. . . . 8 .	. . . 3	.	. ? . . . . . . S K	—— pratensis.
0 . 2 3 4 5 . . 8 9	0 1 . 3 . . . 7 . 9	50	F A G I L C N P S K	—— crispus.
. . . . . 5	. . . .	.	. A G . L . . . S K	—— Hydrolapathum.
. . . . 8 .	? . . . . . . 7 . .	.	. A G . . . . . S K	—— aquaticus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P . K	—— alpinus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— scutatus.
. . . .	0	.	. . . I	—— tuberosus.
. . . 3 4 5 6 7 8 9	. . . 3 4	.	F A G I L C N ? . K	—— arifolius.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 . .	50	F A G I L C N P S K	—— Acetosa.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Acetosella.
. . . .	. . . .	.	. . . .	—— ——, var. (R. acetoselloides).
0 . 2 3 4 5 6 7 8 9	. . 2 3 4 5 . 7 . 9	.	F A G I . . . P S K	Oxyria digyna.
. . 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 . 8 .	50	F A G I L C N P S K	Polygonum Bistorta.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	.	F A G I L C N P S K	—— viviparum.
. . 2 . 4 5 . . 8 9	0 1 . 3 . . . 7 . .	.	F A G I L C N P S K	—— amphibium.
. . 2 . 4 5 . . 8 9	0 1 . 3 4 5	.	F A G I L C N P S K	—— lapathifolium.
0 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— Persicaria.
. . . . 4 5 . 7 8 .	. . . 3	.	. A G I . C N P S K	—— mite.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— Hydropiper.
. . . . 4 . . . 8 .	0	.	F A G ? . . . P S K	—— minus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— aviculare.
. . . .	0 . 2 3 . . 6 . . .	.	. . . I L C N ? . K	—— ——, var. (P. Bellardi).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 . 5 . 7 . .	50	F A G I L C N P S K	—— Convolvulus.
0 . 2 3 4 5 . 7 8 9	. 1 . 3 . 5 . 7 . .	.	F A G I L C N P S K	—— dumetorum.
. . . 3	. . . .	.	F A . . L C . P S K	—— alpinum.
. . 2 . 4 5	0 1 . 3	.	F A ? I L C N P . K	Passerina annua.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Daphne Mezereum.
. 1 2 . 4	0 1 . 3 . . . . 8 .	.	F A G I L C N P . K	—— Laureola.
0 . 2 . 4	0 1 . 3 . . . 7 . .	50	F A G I L C N P . K	—— alpina.
. . . . 4 5 . 7 8 9	0 1 . 3 4 . . 7 . .	.	F . G I L . . P . K	—— Cneorum.
0 . . 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 . .	.	F A G I	—— striata.
0 1	. . . .	.	. . . .	—— rupestris.
. . . .	. . . .	.	F . . . . . . P . .	Thymelæa dioica.
. 1 2 3 4 5 . . 8 9	. . . 3 . 5 . 7 . .	.	. A G ? . C N . . ?	Thesium montanum.
0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 . 6 7 . .	.	F A G I L C N ? . K	—— intermedium.
. . . . 7 8 .	. . . .	.	F A G ? . . . P . .	—— pratense.
0 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 . 9	.	F A G I L C ? P S K	—— alpinum.
. . . .	. . . 3 4 5	.	. A G	—— rostratum.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Osyris alba, *Linn.*	. 2	. . . .	. . . .
Hippophaë rhamnoides, *Linn.*	. 2 3 . . . 7 8 9	0 1 2 3 4 5 . . 8 9	0 1 . 3 4 5 6 7 8 .
Aristolochia rotunda, *Linn.*	?	. . . . 4 . 6 . . 9	. . 2 . 4 5 . . 8 .
—— pallida, *Willd.*	1 . . . . 6 . 8 9	. . . . . . 6 . . .	. 1 2 . . . . 7 8 .
—— Clematitis, *Linn.*	1 2 . . . . . 8 .	. . . . . . 6 . . 9	. . 2 . 4 . 6 7 8 9
Asarum europæum, *Linn.*	. 2 3 . 5 6 . . .	. . 2 . . . 6 . . 9	. . 2 . 4 5 6 7 8 .
Empetrum nigrum, *Linn.*	1 2 . . 5 . . 8 9	. 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 6 7 8 .
Buxus sempervirens, *Linn.*	1 2 . 4 . . . 8 .	. . . . . . ? . . .	. . 2 . . . .
Euphorbia Chamæsyce, *Linn.*	?	. . . . ?	. . . . 7 . .
—— trinervis, *Bert.*	. . . .	. . . .	. . . . 8 .
—— helioscopia, *Linn.*	1 2 3 4 . . 7 8 9	. 1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— platyphylla, *Linn.*	1 2 . 4 . . . 8 9	 9	0 . 2 . . . . 7 8 9
—— dulcis, *Jacq.*	1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 . . 9	. . 2 . 4 5 . 7 8 9
—— angulata, *Jacq.*	. . . .	. . . .	. . . .
—— carniolica, *Jacq.*	. . . .	. . . . . . ? . . .	. . . . . . 6 7 8 9
—— verrucosa, *Lam.*	1 2 . . . 6 . 8 ?	. . . . . . ? . . 9	. . 2 . . . 6 7 8 9
—— epithymoides, *Jacq.*	. . . .	. . . .	. . . .
—— serrata, *Linn.*	1 2	. . . . 4	. . . .
—— Gerardiana, *Jacq.*	 9	. 1 2 . 4 . 6 . . 9	. . . .
—— amygdaloides, *Linn.*	1 2 . 4 . . 7 8 9	0 . . . 4 5 6 . 8 9	0 1 2 . 4 5 6 7 8 9
—— Characias, *Linn.*	1 2	. . . .	. . . .
—— procera, *Bieb.*?	. . . .	. . . .	. . . .
—— dendroides, *Linn.*	. . . .	. . . .	. . . .
—— spinosa, *Linn.*	1 2	. . . .	. . . .
—— Cyparissias, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— Esula, *Linn.*	. . . .	. . . . 8 .	. . . . 4 . . 7 8 .
—— saxatilis, *Jacq.*	. . . . 8 .	. . . .	. . . .
—— nicæensis, *All.*	1 . . . . . . 8 .	. . . .	 9
—— ——, var. (E. Baselicis, *Ten.*)	. . . .	. . . .	. . . .
—— segetalis, *Linn.*	? 2	. . . .	. . . .
—— Peplus, *Linn.*	1 2 . . . . 7 8 9	. 1 . 3 4 5 6 7 8 .	0 1 2 3 4 . 6 7 8 9
—— falcata, *Linn.*	1 2 . 4 . . . 8 .	. . . .	. . 2 . . . . 7 8 .
—— exigua, *Linn.*	1 2 3 4 . . 7 8 .	 9	. . . . 7 8 .
—— variabilis, *Ces.*	1	. . . .	. . 2 . . . 6 7 . .
—— taurinensis, *All.*	. 2 . . . . . 8 .	. . . . . . 6 . . .	. . . .
—— Lathyris, *Linn.*	. . . .	. . . . . . 6 . . 9	. . 2 . 4 . 6 . . ?
Mercurialis perennis, *Linn.*	1 2 3 4 9	. 1 . . 4 . 6 . . 9	. . 2 . . . 6 7 8 .
—— ovata, *Sternb. et Hoppe*	. . . .	. . . .	. . . .
—— annua, *Linn.*	1 2 . 4	. . . . 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Urtica urens, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 . . . 6 . . 9	. . 2 . 4 5 . 7 8 9
—— dioica, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Parietaria erecta, *Mert. & Koch*	. . . . . . 7 . .	. . . . . . 6 . 8 .	. . 2 . 4 5 . 7 8 9
—— ——, var. (P. diffusa, *Mert. & Koch*).	1 2 3 4 . . 7 8 9	. . . 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9
Humulus Lupulus, *Linn.*	1 2 3 4 . . 7 8 9	. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .
Celtis australis, *Linn.*	1 . . . . . . 8 9	. . . . 4 . 6 7 . 9	0 . 2 3 4 . 6 7 8 .
Ulmus campestris, *Linn.*	1 2 3 4 . . 7 8 .	. . . 3 4 5 6 7 8 9	0 . 2 3 4 5 6 7 8 .
—— ——, var. (U. suberosa, *Ehrh.*)	. . . .	. . . .	. . 2 . 4 5 6 7 8 .
Fagus sylvatica, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 . . 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Castanea vulgaris, *Lam.*	1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Quercus sessiliflora, *Sm.*	1 2 . . . . 7 8 9	. . . . . . 6 . 8 9	. . 2 . 4 . 6 7 8 .
—— ——, var. (Q. apennina, *Guss. an Lam.*?)	. . . .	. . . .	. . . .
—— pedunculata, *Ehrh.*	1 2 3 4 5 . . 8 9	. . . . . . 6 . 8 9	0 1 2 . 4 . 6 7 8 9
—— pubescens, *Willd.*	1 2	. . . .	. . 2 . . . 6 7 8 .
—— Cerris, *Linn.*?	? . . . . . . 8 .	. . . . . . 6 . . 9	. . 2 . 4 . 6 7 8 .
—— Ilex, *Linn.*	?	. . . .	. . 2 . . . .
—— Pseudo-suber, *Santi*	. . . .	. . . .	. . . .
Corylus Avellana, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Carpinus Betulus, *Linn.*	1 2 3 4 . . 7 8 9	0 . . . . 5 6 . 8 9	0 . 2 . 4 5 6 7 8 .
Ostrya carpinifolia, *Scop.*	1	. . . .	. . 2 . . . 6 7 8 9

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . .	. . . .	50	F . . I L C N P . .	Osyris alba.
. . 2 3 4 5 6 7 8 9	0 . . 3 4 5 . 7 8 .	.	F A G I L C N . S .	Hippophaë rhamnoides.
. . . .	0 . . 3 . . . . 8 .	.	F . . I L C N . . .	Aristolochia rotunda.
0 1 . 3 4	. 1 2 3 . . . 7 . .	.	. . G I L C N . . K	—— pallida.
. . . 3 4 5 . 7 8 .	0 1 . 3 4 . . 7 8 .	50	F A G I L C N P S K	—— Clematitis.
0 . 2 . 4 5 6 7 8 .	0 1 . 3 . . . 7 8 9	50	F A G I L C N P S K	Asarum europæum.
0 . . 3 ? . 6 7 8 9	. . . 3 . 5 . . . 9	.	F A G ? . C . P S K	Empetrum nigrum.
. . 2 . 4 5	. . . 3 . . . 7 . .	.	F A . I L C N P . .	Buxus sempervirens.
. . . .	0 . . 3	.	F . . I L C N P . ?	Euphorbia Chamæsyce.
. . . . 4	0 . . 3	.	. . . . L . N . . .	—— trinervis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— helioscopia.
0 1 2 . 4 5	0 1 . 3 . . . 7 8 .	50	F A G I L C N P . K	—— platyphylla.
0 1 2 3 4 5	? 1 2 3 4 5 . 7 8 .	50	F A G I L C N P . K	—— dulcis.
. . . . 4 5	. . . 3	.	. . G I . . . P . K	—— angulata.
0 1 2 . 4 5 6 . 8 9	0 1 . 3 4 . . 7 8 .	50	. . G I . . . . . K	—— carniolica.
0 1 2 . 4 5	0 1 . 3 4 5 6 7 8 .	50	? A G I L C N ? . K	—— verrucosa.
. . . .	. . . .	.	. . . .	—— epithymoides.
. . . .	. . . .	.	F . . . L . N ? . .	—— serrata.
. . . . 4 5 . 7 . .	0	.	F A . . . . . P . K	—— Gerardiana.
0 1 2 3 4 5 6 7 . 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	—— amygdaloides.
. . . .	. . . .	.	. . . I L C N P . .	—— Characias.
. . 2 . 4 5 . 7 . .	. . . .	.	. . . .	—— procera.
. . . .	. . . .	50	. . . I L C N . . .	—— dendroides.
. . . .	. . . .	.	F . . I L C N . . .	—— spinosa.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Cyparissias.
. . . . 4	. . . .	.	. ? G I . C . . S K	—— Esula.
. . . .	. . 2 . . . . 7 . .	.	. . . I . . . . . K	—— saxatilis.
0 1 2 . 4 5	0 1 . . . . . 7 8 .	50	F . ? I L C N P . K	—— nicæensis.
. . . .	. . . 3 4 5	.	. . . . L C N . . .	—— ——, var. (E. Baselicis).
. . . .	. . . .	50	? A . I L C N . . K	—— segetalis.
0 1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Peplus.
. . 2 . 4 5	0 1 . 3 . . 6 7 . .	.	F A . I L C N P . K	—— falcata.
. 1 . . 4 5	0 1 . 3 4 5 6 7 8 .	.	F A G I L C N P S K	—— exigua.
. 1	. . . .	.	. . . .	—— variabilis.
. . . .	. . . .	.	F	—— taurinensis.
. 1 . . 4	. . . 3	50	. ? ? I L C N . . K	—— Lathyris.
. . 2 3 4 5 . . 8 .	0 1 2 3 4 5 . 7 . 9	50	F A G I L C N P S .	Mercurialis perennis.
. . . . 4 5	. . . 3	.	. . G I . . ? . . K	—— ovata.
. 1 . 3 4 5 6 7 8 .	0 1 . 3 4 . . 7 8 .	50	F A G I L C N P S K	—— annua.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 .	50	F A G I L C N P S K	Urtica urens.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— dioica.
0 1 2 . . 5 . 7 8 .	. 1 2 3 4 5 . 7 8 9	50	? A G I L C N ? S K	Parietaria erecta.
0 1 2 3 4 5 6 . . .	0 1 2 3 4 5 6 . 8 .	.	F ? ? I L C N P . K	—— ——, var. (P. diffusa).
0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 .	.	F A G I L C N P S K	Humulus Lupulus.
. . 2 . 4 5 . 7 8 .	0 1 . 3 4 5	.	. . G I L C N P . .	Celtis australis.
0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 . . 7 8 9	.	F A G I L C N P S K	Ulmus campestris.
. . 2 . . 5 . 7 8 9	. . . 3 . . . 7 . .	.	. A G I . C N . . .	—— ——, var. (U. suberosa).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Fagus sylvatica.
0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 .	50	F . . I L C N P . .	Castanea vulgaris.
0 . 2 . 4 5 . 7 8 .	0 1 . 3 . . . 7 8 9	50	F A G I L C N P S K	Quercus sessiliflora.
. . . . 4 5 . 7 . .	. . . 3 . . . 7 8 .	50	. . . . L	—— ——, var. (Q. apennina).
. 1 2 . 4 5 6 . . .	0 1 . 3 . 5	50	F A G I ? C N P S K	—— pedunculata.
. 1 . . 4 5 6 7 8 .	0 . . 3	.	F . . I L C N P . K	—— pubescens.
0	0 1	.	. . . I L C N . . K	—— Cerris.
. 1 2 . 4	0	.	F . . I L C N P . .	—— Ilex.
. . . . 4	. . . .	.	. . . . . C N . . .	—— Pseudo-suber.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Corylus Avellana.
0 1 2 . 4 5 . . ? .	0 1 . 3 4 5 . 7 8 .	50	F A G I L C N P S K	Carpinus Betulus.
0 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 . . 8 9	50	F . G I L C N . . .	Ostrya carpinifolia.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Salix pentandra, *Linn.*	. . . . . 6 7 8 .	. . . . . . 6 . . 9	0 . . . . . . 7 8 .
—— fragilis, *Linn.*	. . . . 8 9	. . . .	. . . . 7 8 .
—— alba, *Linn.*	1 2 . . . . 7 8 9	0 . . . 4 . 6 . 8 9	0 . 2 . 4 . 6 7 8 9
—— ——, var. (S. vitellina, *Linn.*)	. . . . 8 9	. . . . . . 6 . 8 .	. . . . 7 8 .
—— amygdalina, *Linn.*	. . . . 8 9	. . . . 8 .	. . 2 . 4 5 6 7 8 .
—— daphnoides, *Vill.*	. . . . 8 .	. . . .	. . . . 7 8 .
—— Pontederana, *Schleich.* (hybr.)	. . . . . 6 . 8 .	. . . . . . ? . . .	. . . .
—— purpurea, *Linn.*	1 2 . . . 6 . . .	. . 2 . . . 6 7 . .	. . 2 . . . . 7 8 9
—— ——, var. (S. Helix, *Linn.*)	. . 3 . . . . 8 .	. . . . 7 . .	. . . . 7 8 .
—— rubra, *Huds.*	. . . .	. . . .	. . . . 7 8 .
—— viminalis, *Linn.*	. . . . . 6 7 8 9	. . . . . . 6 . . 9	0 1 2 . . . 6 7 8 .
—— incana, *Schrank*	1 2 3	. . . .	. . . . 7 8 .
—— cinerea, *Linn.*	1 2 . . . 6 . . .	. . . 3 . 5 . ? 8 .	0 . 2 . 4 5 . 7 8 9
—— nigricans, *Fr.*	1 2 . . . 6 . 8 .	. . 2	. . 2 . 4 5 6 7 8 9
—— grandifolia, *Ser.*	. . . . 8 .	. . 2 . 4 5 6 7 . .	. . 2 . . . . . 8 .
—— Caprea, *Linn.*	1 . . . . . . 8 9	. . 2 . 4 5 6 . . .	. . 2 . 4 . 6 7 8 9
—— aurita, *Linn.*?	. . . .	. . . .	. . 2 . ? . . 7 8 .
—— glabra, *Scop.*	. . . . 8 .	. 1	. . . . 7 8 .
—— phylicifolia, var. Hegetschweileri, *Heer.*	. . . .	. . . .	. . . . 7 . .
—— hastata, *Linn.*	. . . . . 6 . ? .	. . . . ? .	. . . . 7 8 .
—— ambigua, *Ehrh.*?	. . . .	. . . . ?	. . . . 8 .
—— repens, *Linn.*	. . . .	. . 2	. . . . 7 8 .
—— ——, var. (S. rosmarinifolia, *Linn.*).	. . . .	. . . .	. . . . . . 6 7 8 .
—— Arbuscula, *Linn.*	. . 3 . 5 6 . 8 .	. . . .	. . 2 . 4 5 . 7 8 .
—— Lapponum, *Linn.*	. . 3 . 5 6 . . .	. . 2 3 . 5 6 7 8 9	. 1 2 . 4 . 6 . 8 .
—— glauca, *Linn.*	. . . . 8 .	. . 2 3 4 5 6 . ? .	. 1 ? . 4 5 . 7 8 .
—— cæsia, *Vill.*	. . . . . . 7 8 9	. . 2 . 4 . . . 8 .	. . . . 8 .
—— Myrsinites, *Linn.*	. 2 3 . . 6 . 8 .	. . 2 . 4 5 6 7 . .	. . . . 4 5 . 7 8 9
—— ——, var. (S. Jacquiniana, *Willd.*).	. . . .	. . . .	. . . . 7 8 .
—— reticulata, *Linn.*	1 2 3 4 5 6 7 8 .	. 1 2 3 4 5 6 7 8 .	. 1 . . 4 5 6 7 8 9
—— retusa, *Linn.*	1 2 3 . 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	. 1 2 . 4 5 6 7 8 .
—— ——, var. (S. serpyllifolia, *Scop.*)	. 2 . . . . . 8 9	. 1 . . . . . . 8 .	. . . . 4 . . . 8 .
—— herbacea, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 .
Populus alba, *Linn.*	1 2 3 4 . . . 8 9	. 1 2 3 4 . 6 . . 9	. . 2 . 4 . 6 7 8 .
—— canescens, *Sm.*	. . 3	. 1 . . . . 6 . . 9	. . . . 4 . . . . .
—— tremula, *Linn.*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— nigra, *Linn.*	1 2 3 4 5 6 7 8 9	. . . . . . 6 7 . 9	0 . 2 . 4 5 6 7 8 9
Betula alba, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— gummifera, *Bert.*	. . . .	. . . .	. . . . . . 6 . . .
—— pubescens, *Ehrh.*	. . . .	. . . . 7 . .	. . . . 7 8 .
—— humilis, *Schrank*?	. . . .	. . . . . . 6 7 8 .	. . . . 4 5 6 . 8 .
Alnus viridis, *DC.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— glutinosa, *Gærtn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— brembana, *Rota*	. . . .	. . . .	. . . . 7 . .
—— incana, *Willd.*	1 2 . . 5 . 7 8 9	0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9
Ephedra distachya, *Linn.*	. . . . 8 .	. . . .	. . . .
Taxus baccata, *Linn.*	1 . . . . . 7 8 .	. . . . 4 . 6 . 8 9	. . 2 . 4 . 6 7 8 .
Juniperus communis, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— nana, *Willd.*	1 2 3 4 . . . 8 9	0 1 2 3 4 5 6 7 8 .	0 1 . . 4 5 6 7 8 9
—— Oxycedrus, *Linn.*	1 2 . . . . . 8 .	. . . .	. . . .
—— phœnicea, *Linn.*	1 2	. . . .	. . . .
—— Sabina, *Linn.*	. . 3 . . 6 . 8 .	. 1 2 3 4 5	. . . . 4 . . 7 8 .
Pinus sylvestris, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 .	0 . 2 3 4 5 . 7 8 9
—— Mughus, *Scop.*	? . ? . ?	? . ?	. . 2 . 4 5 6 7 8 9
—— nigricans, *Host*	. . . .	. . . .	. . . .
—— Cembra, *Linn.*	1 2 3 4 5 . 7 8 .	. . 2 3 4 5 6 7 8 .	. . . . 4 5 . 7 8 .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . . . 5 . 7 8 9	. . . 3 4	.	F A G I . . N P S K	Salix pentandra.
. . . . 8 .	. . . . 7 . .	.	F A G I . . ? P S K	—— fragilis.
. . 2 3 4 5 6 . 8 9	0 1 . 3 . . . 7 . .	50	F A G I L C N P S K	—— alba.
. . . . . 5 . . 8 .	. . . 3 . . . 7 . .	50	. A . . . C N . . .	—— ——, var. (S. vitellina).
. . . . 4 5 . 7 8 9	0 1 . 3 4 . . 7 . .	50	F A G I L C N P S K	—— amygdalina.
. . . . 7 8 9	. . . 3 . . . . 8 .	.	F . G . . . . . S K	—— daphnoides.
. 1 . . 4 . . . 8 9	. . . .	.	. A G I	—— Pontederana (hybr.).
. 1 2 3 4 5 6 7 8 9	0 1 2 3 . . . 7 . .	50	F A G I L C N P S K	—— purpurea.
. . . .	. . . . 7 . .	.	. A . . . C N . . .	—— ——, var. (S. Helix).
. . . .	. . . .	50	F A G . . . . P . K	—— rubra.
. . . . 8 .	. . . . 7 . .	.	F A G I . . . P S K	—— viminalis.
. 1 2 3 4 5 6 7 8 9	0 1 . 3 4 . . 7 . .	50	F A G I L C N P . K	—— incana.
. 1 2 . 4 5 . . 8 .	0 1 . 3 4 . . 7 . .	50	F A G I L C N P S K	—— cinerea.
. 1 2 3 4 5 . . 8 9	0 1 2 3 4 5 . 7 . 9	50	F A G I L C N . S K	—— nigricans.
. . . 3 4 5 6 7 8 9	0 . 2 3	50	F A G I L C N . . K	—— grandifolia.
0 1 . 3 4 5 . . 8 9	0 1 2 3 . . . 7 . 9	.	F A G I L C N P S K	—— Caprea.
0 . . . ? ?	. . . . 7 . .	.	F A G I L . . P S K	—— aurita.
. 1 2 3 4 5 . 7 8 .	0 . . 3 4 5 . 7 . 9	.	. . G I . C . . S K	—— glabra.
. . . . 7 . .	. . . .	.	. A	—— phylicifolia, var. Hegetschweileri.
. . . . 4 . . 7 8 9	. 1	.	F A G ? L . . P S K	—— hastata.
. . . . 4 5	0	.	? A G . . . . ? S K	—— ambigua.
. . . . 4 . 6 7 8 .	. . . . 4 . 6 . . .	50	F A G I . . . P S K	—— repens.
0 . . . . 8 .	. . . .	.	. . . . S ?	—— ——, var. (S. rosmarinifolia).
0 . . . 4 5 6 7 8 9	0 1 . 3 4 . . 7 . .	.	F A G I . . . P S K	—— arbuscula.
. . . 3 . . 6 7 8 .	. . . .	.	. A G ? . . . . S K	—— Lapponum.
. . . . . . 6 7 . 9	. . . .	.	F ? ? . . . . . S .	—— glauca.
. . . . . 5 . 7 . 9	. . . . 4	.	F A ?	—— cæsia.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 9	.	F A G . . . N ? S K	—— Myrsinites.
. . . . . . 6 . 8 9	. . . 3 4 5 . 7 . 9	.	. . G	—— ——, var. (S. Jacquiniana).
0 1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 . 9	.	F A G I L . . P S K	—— reticulata.
0 . 2 3 4 . 6 7 8 9	. . 2 3 4 5 6 7 8 9	50	F A G I L ? N P S K	—— retusa.
. . 2 . . . . 7 8 .	. . 2 . . . . 7 . .	.	F . G I L . . P . K	—— ——, var. (S. serpyllifolia).
0 1 . 3 4 . 6 7 8 9	. . 2 3 4 . . 7 . .	.	F A G I . . N P S K	—— herbacea.
. . 2 . 4 5 . . 8 .	0 1 . 3 . 5	.	F A G I L C N P . K	Populus alba.
. . 2 . . 5 6 . . .	. . . 3	.	. A ? I . C N ? . .	—— canescens.
0 1 . 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— tremula.
0 1 . . 4 5 6 7 8 .	0 1 . 3 . . . 7 8 9	.	F A G I L C N P ? K	—— nigra.
0 1 . 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	Betula alba.
. . . .	. . . .	.	. ?	—— gummifera.
. . . . 8 9	. . . . 8 .	.	F A G I . . . ? S K	—— pubescens.
. . . . 7 . .	. . . .	.	. . G . . . . . S K	—— humilis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	.	F A G I L . . . S K	Alnus viridis.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— glutinosa.
. . . .	. . . .	.	. . . .	—— brembana.
0 1 . 3 4 5 6 . 8 9	0 1 . 3 4 5 6 7 8 9	50	F A G I L C ? P S K	—— incana.
. . . . . 5 . 7 . .	. . . 3	.	F A	Ephedra distachya.
0 1 2 . 4 5 6 7 8 9	0 1 2 3 . 5 . 7 . .	.	F A G I L C N . S K	Taxus baccata.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Juniperus communis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . . 7 . 9	50	F A G I L C N P S K	—— nana.
. . . .	. . . .	.	. . . I L C N . . .	—— Oxycedrus.
. . . .	. . . .	.	. . . I L C N P . .	—— phœnicea.
. . . 3 . 5 6 . 8 9	. . 2 . 4 . . 7 . .	.	F A G I L . N P . K	—— Sabina.
0 1 . 3 4 5 6 7 8 9	. . 2 3 4 5 . 7 8 9	50	F A G I L C . P S K	Pinus sylvestris.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L . . . . K	—— Mughus.
. . . .	. . . . 7 . .	.	. . G I . . . P . ?	—— nigricans.
. . . 3 . . 6 7 8 9	. . . 3 4 5	.	F A G I L . . . S K	—— Cembra.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Abies Larix, *Lam.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— pectinata, *DC.*	1 2 . 4 . . . 8 .	. 1 2 3 4 5 6 . 8 9	0 1 2 . 4 5 6 7 8 9
—— excelsa, *Poir.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Alisma Plantago, *Linn.*	1 2 3 4 . 6 . 8 9	. . . . 4 . 6 7 8 9	0 . 2 . 4 . 6 7 8 9
—— parnassifolium, *Linn.*	. . . .	. . . . . . 6 . . .	. . . .
Sagittaria sagittæfolia, *Linn.*	. . . .	. . . . . . 6 . . 9	. . . . 4 . 6 . . .
Butomus umbellatus, *Linn.*	. . . . 8 .	. . . .	. . . .
Scheuchzeria palustris, *Linn.*	. . . .	. . . .	. . . .
Triglochin palustre, *Linn.*	1 2 3 4 . 6 7 8 9	. 1 2 3 . 5 6 . 8 9	0 1 2 . 4 5 . 7 8 9
Potamogeton natans, *Linn.*	1 . . . . . . 8 .	. . . . . . 6 . . 9	0 . 2 . . . . 7 8 .
—— ——, var. (P. fluitans, *Roth*)	. . . .	. . . .	. . . . 7 8 .
—— gramineus, *Linn.*	. . . .	. . . . . . 6 . . .	. . 2 . . . 6 7 8 .
—— ——, var. (P. augustanus, *Balb.*)	. . . .	. . . 3	. . . .
—— lucens, *Linn.*	1 2 . . . . . 8 .	. . . . . . 6 . . 9	. . 2 . 4 . . 7 8 .
—— perfoliatus, *Linn.*	. . . .	. . . . . . 6 . 8 9	. . 2 . 4 5 . 7 8 .
—— crispus, *Linn.*	. . . . 8 .	. . . .	. 1 2 . 4 . 6 7 8 .
—— rufescens, *Schrad.*	1 2 . . . . 7 . .	. . . 3 4	. . . .
—— plantagineus, *Du Croz*	. . . .	. . . .	. . . .
—— compressus, *Linn.*	. . . .	. . . .	. . . .
—— pusillus, *Linn.*	. . . . 8 .	. . . . . . 6 . . .	. . . . 7 8 .
—— pectinatus, *Linn.*	. . 3 . . . . 8 .	. . . .	. . . . . . 6 7 8 .
—— marinus, *Linn.*	1 . . . . 6 . 8 .	. . . .	. . . .
—— densus, *Linn.*	. . . . 8 9	 9	. . 2 . . 6 7 8 .
—— ——, var. angustifolius, *Koch*	. . . .	. . . .	. . . .
Zannichellia palustris, *Linn.*	. . . . 8 9	. . . . . . 6 . . 9	. . 2 . 4 . 6 . . .
Naias major, *Roth*	. . . . 8 .	. . . . . . 6 . . 9	0 . 2 . . . .
—— minor, *All.*	 9	. . . .	. . 2 . . . .
Lemna trisulca, *Linn.*	. . . . 8 9	. . . . . . 6 . . .	. . 2 . . . 6 . . .
—— polyrhiza, *Linn.*	. . . . 8 .	. . . .	. . 2 . . . 6 . . .
—— minor, *Linn.*	1 2 . 4 . . . 8 .	. 1 . . 4 5 6 . . .	. . 2 . 4 . 6 7 8 .
—— gibba, *Linn.*	 9	. . . .	. . . .
Typha angustifolia, *Linn.*	. . . . 8 9	 9	. . . . 4 . . . 8 .
—— latifolia, *Linn.*	. . . . 8 .	. . . . 8 9	. . 2 . 4 . 6 . 8 .
—— minor, *Sm.*	. . . .	. . . .	. . . .
Sparganium ramosum, *Huds.*	. . . .	. . . . . . 6 . . 9	0 . 2 . . . 6 7 8 .
—— simplex, *Huds.*	. . . . 8 .	. . . . . . 6 . . .	. . 2 . . . 6 . . .
—— natans, *Linn.* ?	. . . . 8 .	. . . . . . 6 . 8 9	 9
Arum maculatum, *Linn.*	? ? . . . . . 8 .	. . . .	. . 2 . . . 6 . 8 .
—— italicum, *Mill.*	1 2	. . . .	. . 2 . . . . 7 8 9
—— Dracunculus, *Linn.*	. . . . . 6 . 8 .	. . . .	. . . .
Acorus Calamus, *Linn.*	. . . 4	. . . .	. . 2 . . . .
Orchis fusca, *Jacq.*	. 2	. . . . . . 6 . 8 .	. . . . 8 .
—— militaris, *Linn.*	1 2 . 4 . . . 8 .	. . . . 8 .	. . 2 . . . 6 7 8 .
—— Simia, *Lam.*	1 . . . . . . 8 9	. . . .	. . . . . . 6 7 8 .
—— variegata, *All.*	. 2 . 4 . 6 . 8 .	. . . .	0 . 2 . . . 6 7 8 .
—— ustulata, *Linn.*	1 2 . 4 5 . 7 8 9	0 9	. . 2 . . . 6 . 8 9
—— coriophora, *Linn.*	1 2 . . . . . 8 9	. . . . . . 6 . . 9	. . 2 . 4 . . . 8 9
—— globosa, *Linn.*	1 2 . 4 . . 7 8 .	. . 2 . . 5 6 . 8 9	. . 2 . 4 . 6 7 8 9
—— Morio, *Linn.*	1 2 . 4 . . . 8 9	. . . . . . 6 7 . 9	. . 2 . 4 . 6 7 8 9
—— Spitzelii, *Saut.*	. . . .	. . . .	. . . . 7 8 .
—— pallens, *Linn.*	1 2 . . . . . 8 .	. . . .	. . . . . . 6 7 8 .
—— provincialis, *Balb.*	. . . .	. . . .	. . . . . . 6 7 8 .
—— mascula, *Linn.*	1 2 . 4 . . . 8 .	. . . . . . 6 7 8 9	0 . 2 . 4 5 6 7 8 .
—— laxiflora, *Lam.*	. . . .	. . . . . . 6 . . .	. . 2 9
—— sambucina, *Linn.*	1 2 3 4 5 . 7 8 9	. 1 2 3 4 5 6 7 8 9	0 . . . 4 5 6 7 . 9
—— rubra, *Jacq.*	 9	. . . . 4	. . 2 . 4 . 6 . . .
—— maculata, *Linn.*	1 2 3 4 5 6 7 8 9	0 . 2 3 . 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— latifolia, *Linn.*	1 2 . . . . . 8 .	. . . . . . 6 . . .	. . . . 4 . . 7 . .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	.	F A G I L . . . . K	Abies Larix.
0 1 2 3 4 5 6 7 8 9	. . 2 3 4 5 . 7 8 9	.	F A G I L C N P . K	—— pectinata.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I . . . P S K	—— excelsa.
0 1 . 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	Alisma Plantago.
. . . . . 5	. . . .	.	? . . . . C ? . . .	—— parnassifolium.
. . . . 4	. . . .	.	F A G ? L C . ? S K	Sagittaria sagittæfolia.
. . . . . 5	. . . .	.	. A G I . C N . S K	Butomus umbellatus.
. . . . 8 .	. . . .	.	F A G . . . . P S K	Scheuchzeria palustris.
. . . 3 4 5 6 7 8 9	. . 2 3 4 5 . 7 8 .	.	F A G I L ? N P S K	Triglochin palustre.
. . 2 . 4 5 6 . 8 9	. . . . 4 . . 7 . .	.	F A G I L C N P S K	Potamogeton natans.
. . . . 4 5	. 1	.	. A ? I . . N ? S .	—— ——, var. (P. fluitans).
. . . . . 5 . . 8 .	. . . .	.	. A G . . . . P S K	—— gramineus.
. . . . . 5 . . 8 9	. . . .	.	. . . . N . ? .	—— ——, var. (P. augustanus).
. . 2 . 4 5 . 7 8 9	. . . .	50	F A G I L C N P S K	—— lucens.
. . 2 . 4 5	. . . 3 . . . 7 . .	.	? A G I L C N P S K	—— perfoliatus.
. . . . 4 5 . . . 9	0 1 . . . . . 7 8 .	.	F A G I ? C N P S K	—— crispus.
. . . . . 5 . . 8 .	. . . . . 5	.	. A G ? . . . . S .	—— rufescens.
. . . . . 5	. . . .	.	F A . . L . . . S .	—— plantagineus.
. . . . 4	. . . .	.	. A . ? . C . . S K	—— compressus.
. . 2 3 4 5 6 7 8 9	. . . 3 . . . 7 . .	.	F A G I L C ? P S K	—— pusillus.
. 1 2 . 4 . . 7 . .	0	.	F A G I L C N ? S K	—— pectinatus.
. . . . 8 9	. . . . 4	.	F . . . . S K	—— marinus.
. . 2 . 4	. . . .	.	F A G I L C N P . K	—— densus.
. . . . 9	. . . .	.	. . . .	—— ——, var. angustifolius.
. . . . . 5 . . 8 9	. . . 3 . . . 7 . .	.	? A G I L C N P S K	Zannichellia palustris.
0 . . . 4	0	.	. A . ? ? C N . S K	Naias major.
0 . 2 . 4 5	. . . .	.	. A G ? . C ? . . K	—— minor.
. . . . 4 5 . . . 9	0 . . 3	.	F A G I L C N P S K	Lemna trisulca.
. . 2 . 4	0 . . 3 . . . . 8 .	.	? A ? ? ? C N ? S K	—— polyrhiza.
. . 2 . 4 5 6 7 8 9	0 . . 3 . 5 . 7 . .	50	F A G I L C N P S K	—— minor.
. . . . 4 5	. . . .	.	? A G I L C N P S K	—— gibba.
. . . . . 5	. . . 3 . . . . 8 .	50	F A G I L C N P S K	Typha angustifolia.
0 . . . 4 5 6 7 8 .	0 . . 3 . 5 . 7 . .	.	F A G I L C N P S K	—— latifolia.
. . . . 4 5 . 7 . .	0 . . 3 . . . 7 . .	.	F A G . . C N . . ?	—— minor.
0 . . . 4 5 . . . 9	. . . 3 4 5	50	F A G I L C N P S K	Sparganium ramosum.
. . . . . 5 . . 8 9	. . . 3	.	F A G I ? C N P S K	—— simplex.
0 . 2 . 4 5 . 7 8 9	. . . 3	.	. A G . . . . P S K	—— natans.
. 1 . . 4	0 1 . 3 . . . 7 . .	.	F A G I L C N P S K	Arum maculatum.
. . 2 . 4	0 . . 3 . . . . 8 .	50	. . . I L C N ? . K	—— italicum.
. . . .	. . . . 7 . .	50	. . . I L C N ? . .	—— Dracunculus.
. . . .	0 . . 3	.	F A G I . C . P S K	Acorus Calamus.
. . . . 4 5 6 . . .	0 1 . 3 . . . 7 . .	.	. A G I L C N P . K	Orchis fusca.
0 . . 3 4 5 . 7 8 9	0 1 2 3 . . . 7 8 .	.	F A G I L C N P . K	—— militaris.
. 1 . . 4 5	0 . . 3	.	F A . I . C N . . .	—— Simia.
. . . 3 4 5 . 7 . .	. 1 2 3 . . . 7 . .	50	. . G I L C N . . K	—— variegata.
0 1 2 3 4 5 6 . 8 9	0 1 2 3 . . . 7 8 .	50	F A G I L C N P S K	—— ustulata.
. . . 3 4 5 . 7 8 9	0 1 . 3 . 5 . 7 8 .	.	F . . I L C N P . K	—— coriophora.
0 1 2 3 4 5 . . 8 9	0 1 2 3 4 . . 7 8 .	.	F A G I L C . P . K	—— globosa.
0 1 2 . 4 5 . 7 8 9	0 1 2 3 . . 6 7 8 9	50	F A G I L C N P S K	—— Morio.
0 1 2 . 4 . 6 . . .	. . . .	.	. . G	—— Spitzelii.
. 1 2	0 1 . 3	.	F A G I L C N ? . K	—— pallens.
. . . . 4	. . . .	.	. . . I L C N . . .	—— provincialis.
0 . . 3 4 5 . 7 8 9	0 1 2 3 4 . . 7 8 .	50	F A G I L C N P S K	—— mascula.
. 1 2	. . . 3	.	. A . I L C N P . K	—— laxiflora.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . .	.	F A G I L C N P S K	—— sambucina.
. . . .	0 . . 3	.	. . . I L C N . . K	—— rubra.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . . 7 8 .	50	F A G I L C N P S K	—— maculata.
. . . . 4 5 . 7 8 9	. . 2 3 4 . . 7 . .	50	F A G I L C N P S K	—— latifolia.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Orchis latifolia, var. (O. incarnata, *Linn.*)	. . . . . 6 . 8 .	. . . . . . 6 . . 9	. . 2 . . . .
—— ——, var. (O. Traunsteineri, *Saut.*).	. . . .	. . . .	. . . .
Anacamptis pyramidalis, *Rich.*	1 . . 4 . . 7 8 9	. . . . . . 6 . . .	. . . . 4 . . 7 8 .
Gymnadenia conopsea, *R. Br.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 . 2 . 4 5 6 7 8 9
—— odoratissima, *Rich.*	1 2 . 4 . . 7 8 .	. . . . . . 6 . . 9	. 1 2 . 4 5 6 7 8 9
—— albida, *Rich.*	1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 .	. . . . . 5 6 7 8 9
Himantoglossum hircinum, *Rich.*	. . . .	 9	. . . . 8 9
Cœloglossum viride, *Hartm.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 . . 4 5 6 7 8 9
Platanthera bifolia, *Rich.*	1 2 3 4 . . . 8 9	. . . . . . 6 . 8 9	0 1 2 . 4 5 . 7 8 9
—— chlorantha, *Cust.*	. 2	. . . .	. . . . 7 . 9
Nigritella angustifolia, *Rich.*	1 2 . . 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9
—— ——, var. flor. roseo, *Parl.*	1 2 3 4 5 6 . . .	. . . .	. . . .
—— suaveolens, *Koch*	. . . .	. . . .	. ? 9
Ophrys muscifera, *Huds.*	1 2 . . . . . 8 .	. . . . . . 6 . . 9	. . 2 . 4 . . . 8 .
—— aranifera, *Huds.*	1 2 . . . . . 8 .	. . . .	. . 2 . . . . 7 8 .
—— Bertolonii, *Moretti*	. . . .	. . . .	. . . . . . 6 7 . .
—— Arachnites, *Reichard*	. . . . 8 .	. . . .	. . 2 . . . 6 7 8 9
—— apifera, *Huds.*	1 2	. . . .	. . . . 7 8 9
Chamæorchis alpina, *Rich.*	. . . . 5 6 . 8 .	. . . . . 5 6 . . .	. . . . 4 . . . 8 .
Aceras anthropophora, *R. Br.*	1 2	. . . . . . 6 . . .	. . 2 . . . . 7 8 .
Herminium Monorchis, *R. Br.*	1 2 . 4 . . 7 8 .	. . 2 . 4 . 6 . . 9	. . 2 . 4 5 6 . 8 9
Serapias Lingua, *Linn.* ?	. . . . 8 9	. . . .	. . 2 . 4 . . 7 8 .
—— longipetala, *Pollini*	1 2	. . . .	? . 2 . . . . 7 8 .
Epipogum Gmelini, *Rich.*	1 . 3	. . . .	. . . .
Limodorum abortivum, *Swartz*	1 2 . . . . . 8 .	. . . .	. . 2 . . . . 7 8 9
Cephalanthera pallens, *Rich.*	1 . . . . . . 8 9	. . . . 7 . .	. . . . 7 . .
—— ensifolia, *Rich.*	1 2 3	. . . . . . 6 . . 9	. . 2 . 4 . 6 7 8 9
—— rubra, *Rich.*	1 2 . . . . 7 8 .	. 1 2 . 4 5 6 . . .	0 . 2 . 4 . . 7 8 .
Epipactis latifolia, *All.*	1 2 . 4 . . . 8 9	. . . . . . 6 7 8 .	0 1 2 3 4 . 6 7 8 9
—— ——, var. (E. rubiginosa, *Gaud.*)	1 . . 4 . . 7 . .	. 1 . . 4 . 6 7 . .	. . 2 . . 5 6 7 8 9
—— microphylla, *Ehrh.*	. . . .	. . . .	. . 2 . 4 5 . 7 . .
—— palustris, *Crantz*	. 2	. . . . . . 6 . . 9	. . 2 . . . .
Listera ovata, *R. Br.*	1 2 3 4 . . 7 8 9	. . . . . . 6 . 8 9	. . . . 4 . 6 7 8 9
—— cordata, *R. Br.*	1	. 1 . . . . 6 7 . .	. . . . . 5 . . . .
Neottia Nidus-avis, *Rich.*	1 2 3 . . . . 8 .	. . . . . . 6 . . 9	. . . . . . 6 7 8 .
Goodyera repens, *R. Br.*	1 . . . . . 7 . .	. . . . . . 6 . . .	. . . . 7 . .
Spiranthes æstivalis, *Rich.*	. . 3 . . . . 8 9	 9	0 . 2 . 4 . 6 . . .
—— autumnalis, *Rich.*	. . . . 8 9	. . . .	0 . 2 . . . . 7 8 .
Corallorhiza innata, *R. Br.*	. . 3	. . . .	. . . . . . 6 7 . .
Sturmia Loeselii, *Reichb.*	. . . .	. . . .	. . . .
Malaxis monophyllos, *Swartz*	. . . .	. . . .	. . . .
Cypripedium Calceolus, *Linn.*	1 9	. . . .	. . . .
Crocus biflorus, *Mill.*	. . . .	. . . .	. . . . 7 8 .
—— vernus, *All.*	1 2 3 4 . . 7 8 9	0 . 2 . . . 6 7 8 9	0 . 2 . 4 5 6 7 8 9
—— medius, *Balb.*	. 2	. . . .	. . . .
—— variegatus, *Hoppe*	. . . .	. . . .	. . . .
Gladiolus palustris, *Gaud.*	. . . . 8 .	. . . .	0 . 2 . . . . 7 . .
—— communis, *Linn.*	. . . . 8 .	. . . .	? . 2 . 4 . . 7 8 .
Iris pallida, *Lam.*	. . . . 8 .	. . . .	. . 2 . . . . 7 . .
—— germanica, *Linn.*	1 . . . . . . 8 .	. . . . 4 . 6 . . 9	. . 2 . 4 . . 7 8 .
—— squalens, *Linn.*	. . . .	. . . .	. . . .
—— italica, *Parl.*	. . . .	. . . .	. . . .
—— Pseud-Acorus, *Linn.*	1 . 3 . . . 7 8 9	. . . . 4 . 6 . . .	. . 2 . 4 . 6 7 8 9
—— sibirica, *Linn.*	 9	. . . . 4	. . . .
—— fœtidissima, *Linn.*	. . . .	. . . .	. . . .
—— spuria, *Linn.*	. . . .	. . . .	. . . .
—— graminea, *Linn.*	 9	. . . .	. . 2 . . . 6 7 8 .
—— tuberosa, *Linn.*	. . . .	. . . .	. . . . 7 . .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . . 4 5 6 7 8 9	. . . 3	.	. A G I L ? . P S K	Orchis latifolia, var. (O. incarnata).
. . . . . 5 . . 8 .	. . . .	.	. A G . . . . . S .	—— ——, var. (O. Traunsteineri).
0 1 2 3 4 5 . . 8 .	0 1 2 3 . . . 7 8 .	.	F A G I L C N P S K	Anacamptis pyramidalis.
0 1 2 3 4 5 . 7 8 9	0 1 2 3 4 . . 7 . .	50	F A G I L C N P S K	Gymnadenia conopsea.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I . C . P S K	—— odoratissima.
0 1 2 3 4 5 . 7 8 9	0 1 2 3 4 . . 7 . 9	.	F A G I L C N P S K	—— albida.
. 1 . . 4	0 1 . 3	50	F A G I L C N P . K	Himantoglossum hircinum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . .	50	F A G I L C N P S K	Cœloglossum viride.
0 1 . 3 4 5 . 7 8 9	0 1 2 3 . 5 . 7 . .	.	F A G I L C N P S K	Platanthera bifolia.
. . 2 3 . 5 . . . 9	. . . .	.	F A G I . . N P S .	—— chlorantha.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	.	F A G I L . . P S K	Nigritella angustifolia.
. . . .	. . . 3	.	. . . . . . N . . .	—— ——, var. flor. roseo.
. . . . 7 8 9	. . . .	.	F A G . . . . P . .	—— suaveolens.
. . 2 3 4 5 . . 8 9	0 . . 3 . . . 7 . .	.	? A G I L C N P S K	Ophrys muscifera.
. . 2 . 4 5	0 1 . 3	50	F A G I L C N P . K	—— aranifera.
. . . . 4	. . . 3	.	. . . I L C N . . .	—— Bertolonii
. 1 . . 4 5	0 1 . 3 . . . 7 . .	.	? A ? I L C N P . K	—— Arachnites.
. 1 2 . 4 5 . . 8 .	0 1 . 3	.	F A ? I L C N P . K	—— apifera.
. . . . . 5 . 7 8 9	. . . . . 5 . 7 . 9	.	? A G . . . . . S K	Chamæorchis alpina.
. . . .	0	.	F A . ? L C N P . ?	Aceras anthropophora.
0 1 2 . 4 5 6 7 8 9	0 1 2 3 . . . 7 . .	.	F A G I . . N P S K	Herminium Monorchis.
. . . 4 . . 6 . . .	0 1 . 3 . . . 7 8 .	.	. . . I L C N P . .	Serapias Lingua.
. . . . 4 5	0 1 . 3 . 5	.	. . . . L C N P . .	—— longipetala.
. . . .	. . . .	.	F A G . . C . . S K	Epipogum Gmelini.
. . 2 3 4 5 . 7 8 .	0 1 . 3 . . . 7 . .	.	F A G I L C N P . .	Limodorum abortivum.
. 1 2 3 4 5 . 7 8 .	0 . . 3 . . . 7 . .	.	F A G I L C N P . K	Cephalanthera pallens.
. 1 2 3 4 5 6 . 8 9	0 1 . 3 4 . . 7 . 9	.	? A G I L C N ? S K	—— ensifolia.
. 1 2 3 4 5 6 7 8 9	0 1 2 3 . . . 7 . .	.	F A G I L C N P S K	—— rubra.
0 1 . 3 4 5 6 . 8 9	0 1 . 3 . . . 7 . .	50	F A G I L C N P S K	Epipactis latifolia.
. 1 2 3 4 5 6 7 8 9	. 1 . 3 4 5 6 7 . 9	.	F A G I L C N P S K	—— ——, var. (E. rubiginosa).
. . . .	. . 2	.	. . G I L C N . . K	—— microphylla.
0 . . . 4 5 . 7 8 .	. . . 3 4 5 . 7 . .	.	F A G I L C N P S K	—— palustris.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . . 7 8 9	50	F A G I L C N P S K	Listera ovata.
. . . 3 . . . . 8 9	. . . 3	.	F A G I . C . P S K	—— cordata.
0 . 2 3 4 5 6 7 8 9	0 . 2 3 . . . 7 . .	50	F A G I L C N P S K	Neottia Nidus-avis.
. . 2 . 4 5 6 . 8 9	0 . 2 3 4	.	. A G I . . . P S K	Goodyera repens.
. . 2 . . 5	0 . . 3	.	. A G I L C . P . .	Spiranthes æstivalis.
. . . . 4	0 . . 3	.	F A G I L C N P . K	—— autumnalis.
. . . . 9	0 . 2 3 . . . 7 . .	.	F A G I L C . ? S K	Corallorhiza innata.
. . . . . 5 . 7 . .	. . . 3	.	F A G ? . C . . S K	Sturmia Loeselii.
. . . . 9	. . . .	.	. A G I . . . . S K	Malaxis monophyllos.
0 1 2 3 4 5 . 7 8 9	. . . 3 . . . 7 . .	.	F A G ? . . . P S K	Cypripedium Calceolus.
. 1	?	.	. . . I L C N . . .	Crocus biflorus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P . K	—— vernus.
. . . .	. . . .	.	. . . . L	—— medius.
. . . .	. . . .	50	. . . I	—— variegatus.
0 1 2 . 4 5 . . 8 .	. 1 . 3 . 5	50	. ? G I L C . . . K	Gladiolus palustris.
. . . . 4	. . . .	50	. . . I L C N P . .	—— communis.
. 1 . . 4 5 . . 8 .	. . . .	.	. . . I . C ? . . .	Iris pallida.
. . . . 4 5 . . 8 .	. . . 3 . . . 7 . .	50	? A . I L C N P . K	—— germanica.
. . 2 . . . . . 8 9	. . 2 3	50	. . . . K	—— squalens.
. . . . 4	. . . .	.	. . . . L C	—— italica.
0 1 2 . 4 5 . . . 9	0 1 2 3 . . . 7 8 .	50	F A G I L C N P S K	—— Pseud-Acorus.
. . . . 8 .	. . . . 7 8 .	50	. A G ? . . . . S K	—— sibirica.
. . . . 4	0	.	. . . . L C N P . .	—— fœtidissima.
. . . .	. . . .	50	. . G . . . . . . K	—— spuria.
0 1 2 3 4	0 1 . 3 4 . . 7 . .	50	. . G I L C N P . K	—— graminea.
. . . .	?	.	. . . I L C N . . .	—— tuberosa.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Narcissus poeticus, *Linn.*	1 2 . . . . . 8 9	. . . .	. . 2 . 4 . . 7 8 .
—— incomparabilis, *Mill.*	. . . .	. . . .	. . . .
—— Pseudo-Narcissus, *Linn.*	1 2 . . . . . 8 .	. . . . . . ? . . 9	. . 2 . 4 . 6 . ? .
Leucojum vernum, *Linn.*	. 2 . . . . . 8 .	. . . . . . 6 . . 9	. 1 2 . 4 . . 7 8 .
—— æstivum, *Linn.*	. . . .	. . . .	. . 2 . 4 . . 7 . .
Galanthus nivalis, *Linn.*	. . . .	. . . . . . 6 . . 9	. . 2 . . . 6 7 8 9
Asparagus tenuifolius, *Lam.*	. . . .	. . . .	. . 2 . . . 6 . 8 .
—— officinalis, *Linn.* (spont.?)	. . . .	. . . .	. . . .
—— acutifolius, *Linn.*	1	. . . .	 9
Streptopus amplexifolius, *DC.*	1 2 3 . . . . 8 .	. . . . . . 6 7 8 .	. . 2 . 4 9
Paris quadrifolia, *Linn.*	1 2 3 4 . . 7 8 9	. . 2 . . . 6 . 8 .	0 . 2 . 4 . 6 7 8 9
Convallaria verticillata, *Linn.*	1 2 3 4 . . 7 8 9	0 . . . . 5 6 7 . 9	. 1 2 3 4 5 6 7 8 9
—— Polygonatum, *Linn.*	1 2 3 4 . . . 8 .	. . 2 . 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— multiflora, *Linn.*	1 2 . 4 . . 7 8 9	. . . . . . 6 7 8 9	. 1 2 3 4 . 6 7 8 9
—— majalis, *Linn.*	1 2 3 4 . . 7 8 9	0 . 2 3 4 . 6 7 8 9	0 . 2 . . . 6 7 8 9
Maianthemum bifolium, *DC.*	1 2 3 4 . . 7 8 9	0 1 2 3 . 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Smilax aspera, *Linn.*	1	. . . .	. . . .
Ruscus aculeatus, *Linn.*	. . 3 4 . . 7 8 9	. . . . . 5 6 7 . 9	. . 2 . 4 . 6 7 8 .
Tamus communis, *Linn.*	1 2 . 4 . 6 7 8 9	. . . . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Vallisneria spiralis, *Linn.*	. . . .	. . . .	. . 2 . . . . . 8 .
Hydrocharis Morsus-ranæ, *Linn.*	. . . .	 9	. . . .
Tulipa sylvestris, *Linn.*	. 2 . . 5 . 7 8 .	. . . . . . 6 . 8 .	. . . .
—— præcox, *Ten.*	. . . .	. . . .	. . . . 8 .
Fritillaria montana, *Hoppe*	. . . .	. . . .	. . . . ?
—— delphinensis, *Gren.*	1 2 . . 5	. . . .	. . . .
—— involucrata, *All.*	1 2	. . . .	. . . .
Lilium bulbiferum, *Linn.*	1 2 3 4 . . . 8 .	. . . . . 5 6 7 8 9	0 . 2 . 4 5 6 7 8 9
—— pomponium, *Linn.*	1 2	. . . .	. . . .
—— carniolicum, *Bernh.*	. . . .	. . . .	. . . .
—— Martagon, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
Lloydia serotina, *Salisb.*	1 2 3 . 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	0 . . 3 4 5 6 7 8 .
Erythronium Dens-canis, *Linn.*	1 2 . . . . . 8 .	. . . . . . 6 . . 9	. . 2 . 4 . 6 7 8 .
Asphodelus ramosus, *Linn.*?	. . . .	. . . . ?	. . . .
—— albus, *Mill.*	1 . 3 . . . . 8 .	. . . . 4 5 6 . . .	. . 2 . . . . 7 8 .
Anthericum Liliago, *Linn.*	1 2 3 4 . . 7 8 .	. 1 2 . . 5 6 . 8 9	. 1 2 . 4 5 6 7 8 9
—— ramosum, *Linn.*	1 . 3 4	. . . . 4 5 6 7 . 9	. 1 2 3 . . 6 7 8 9
Paradisia Liliastrum, *Bert.*	1 2 3 4 . . 7 8 .	. . . 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 .
Ornithogalum pyrenaicum, *Linn.*	1 2 . . . . . 8 9	 9	. . 2 . 4 . 6 . 8 9
—— narbonense, *Linn.*	?	. . . . . . ? . . .	. . . .
—— umbellatum, *Linn.*	1 2 3 . . . 7 8 9	. . . . . . 6 . 8 9	. . 2 . 4 5 6 7 8 9
—— nutans, *Linn.*	. 2	. . . .	. . . .
Gagea stenopetala, *Reichb.*	. ?	. . . .	. . . . . . 6 . . .
—— arvensis, *Schult. fil.*	. 2 ?	. . . . 4	. . . . 4 . . 7 8 .
—— Liotardi, *Schult. fil.*	1 2 . 4 . . . 8 .	. . 2 3 4 . 6 . . .	. . . . 4 . . . 8 .
—— lutea, *Schult. fil.*	1 . 3 . 5 . . 8 .	. . . . . . 6 . . 9	. . . . 4 5 . 7 8 .
Scilla amœna, *Linn.*	. . . .	. . . .	. . . .
—— bifolia, *Linn.*	1 2 . . . . . 8 .	. . . . . . 6 . . 9	. . 2 . 4 5 6 7 8 .
—— italica, *Linn.*	. 2	. . . .	. . . .
—— autumnalis, *Linn.*	1 2	. . . .	. . . .
Allium Victorialis, *Linn.*	. 2	. 1	. . 2 . 4 . . . . .
—— ursinum, *Linn.*	. 2 . 4 . . . 8 9	. . . . . . 6 . . .	. . 2 . 4 . 6 7 8 .
—— pedemontanum, *Willd.*	1 2 3 4 . 6 . 8 9	. . . . . . 6 . . .	. . . . . . 6 7 . 9
—— multibulbosum, *Jacq.*	. . . .	. . . .	. . . .
—— neapolitanum, *Cyr.*	. . . .	. . . .	. . . .
—— fallax, *Don*	1 . . . . . . 8 9	0 . 2 . . 5 6 7 8 9	0 1 2 3 4 5 . 7 . .
—— acutangulum, *Schrad.*	. . . . 5 6 . 8 .	0 . 2 . 4 5 6 . 8 9	. . 2 . . . . 7 8 .
—— ochroleucum, *Waldst. & Kit.*	. . . .	. . . .	. . . . 7 . 9
—— suaveolens, *Jacq.*	. . . .	. . . .	. . . .
—— strictum, *Schrad.*	. . . .	. . . . . . 6 . . .	. . . .
—— Ampeloprasum, *Lam.* (spont.?)	. . . .	. . . .	. . . . 7 8 .
—— rotundum, *Linn.*	?	. . . .	. . . . 4 . . 7 8 .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . 2 . 4 ? . 7 8 .	. 1 2 3 4 . . 7 . .	.	F . . I L C N P . K	Narcissus poeticus.
. . . . . 5 . . 8 .	0 . . 3	.	. . . I L C N . . .	—— incomparabilis.
. . . . . 5	. . . . 7 . .	.	F A G I L C N P S K	—— Pseudo-Narcissus.
. . . 3 4 5 . 7 8 .	0 . . 3 . . . 7 8 .	.	F A G I L C . P . K	Leucojum vernum.
. . . .	0 . . . . . . 7 . .	.	. . G I L C . . . K	—— æstivum.
. . . 3 4 5 . . 8 .	0 1 2 3 . . . 7 . .	50	F A G I L C N P . K	Galanthus nivalis.
0 1 . . 4 . . 7 . 9	. . . 3 . . . 7 . .	50	F . G I L C N . . K	Asparagus tenuifolius.
. . . . 4 5 . 7 8 .	. . . 3	50	. . . I L C N P ? K	—— officinalis (spont. ?).
. 1 . . 4 ?	0 1 . 3 . . . . 8 .	50	? . . I L C N P . .	—— acutifolius.
. . 2 3 4 5 6 7 8 9	0 . . 3 4 5 . 7 . .	50	F A G ? L C N P . K	Streptopus amplexifolius.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 .	50	F A G I L C N P S K	Paris quadrifolia.
0 . 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P S K	Convallaria verticillata.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— Polygonatum.
0 1 2 3 4 5 6 7 8 .	0 1 2 3 . 5 . 7 8 .	50	F A G I L C N P S K	—— multiflora.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 . 5 . 7 8 .	50	F A G I L C N P S K	—— majalis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	50	F A G I L . . P S K	Maianthemum bifolium.
. . . .	0	.	. . . I L C N . . .	Smilax aspera.
0 1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 . 7 8 .	.	F ? . I L C N P . K	Ruscus aculeatus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	50	F A ? I L C N P . K	Tamus communis.
. 1 2 . 4 5	0	.	. . . . L C	Vallisneria spiralis.
. . . . 4 5	0	.	. A ? I L C N . S K	Hydrocharis Morsus-ranæ.
. . . .	. . . .	50	F A ? I L C N P S K	Tulipa sylvestris.
. . . .	. . . .	.	. . . . L C N . . .	—— præcox.
. . . . . 5	. . . .	.	. . . I . C N P . K	Fritillaria montana.
. 1	. . . .	.	F	—— delphinensis.
. . . .	. . . .	.	F . . . L	—— involucrata.
0 1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 . .	50	F A G I L C N P S K	Lilium bulbiferum.
. . . .	. . . .	.	. . . . L	—— pomponium.
. . . .	. 1 . . . . . 7 8 .	50	. . G I	—— carniolicum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P . K	—— Martagon.
0 . . 3 . 5 6 7 8 9	. . . . 4 5 . . . 9	.	F A G I . . . . S K	Lloydia serotina.
. 1 . . 4	0 1 . 3 . . . 7 8 .	50	F A G I L C . P . K	Erythronium Dens-canis.
. . . .	. . . . 8 .	.	. . . I . C N P . .	Asphodelus ramosus.
0 1 . . 4 5	0 1 . 3 4 . . 7 . .	.	F . . I L C N P . .	—— albus.
0 . . . 4 5 6 7 8 .	0 1 2 3 4	.	F A G I L C N P S K	Anthericum Liliago.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I ? C ? P S K	—— ramosum.
0 . . 3 4 5 6 7 8 9	. . . 3 . 5 . 7 . .	.	F A G I L C N P . .	Paradisia Liliastrum.
0 1 2 . 4 5 6 7 . .	0 1 . 3 . . . 7 8 .	50	F A ? I L C N P . K	Ornithogalum pyrenaicum.
. . . .	0 1	.	. . . I L C N P . ?	—— narbonense.
0 1 . 3 4 5 . 7 8 9	0 1 . 3 . . . 7 8 .	50	F A G I L C N P S K	—— umbellatum.
. . . . . 5 . 7 8 .	. . . .	.	F A ? ? . . N ? S K	—— nutans.
. . . . . 5	. . . .	.	. A G ? . C . . S K	Gagea stenopetala.
. . . 3 4 5 6 7 . 9	0 1 . 3	50	F A G I L C N ? . K	—— arvensis.
. . . 3 . . . 7 8 9	. . . 3	.	F A G I . C . P . .	—— Liotardi.
. 1 . 3 4 5 . 7 . .	0 . 2 3 . . . 7 . .	.	F A G I L C N P S K	—— lutea.
. . . . . . 6 7 . .	0	50	. . . ?	Scilla amœna.
. . . . 4 5 . 7 . .	0 1 . 3 . . . 7 8 .	50	F A . I L C N P . K	—— bifolia.
. . . .	. . . .	.	F A . . L	—— italica.
. . . 3 4	0 . . . . 8 .	.	? . . I L C N P . .	—— autumnalis.
. . . . 7 8 9	. . . . . . 6 7 8 .	50	F A G I . . . P . ?	Allium Victorialis.
0 . . . ?	0 . . 3 . . . 7 8 .	50	F A G I L C N P S K	—— ursinum.
. . . .	. . . .	.	F . . . L	—— pedemontanum.
. . . . . 5 . . 8 .	. . . .	.	. . . I	—— multibulbosum.
. 1 . . 4	0	.	. . . I L C N . . .	—— neapolitanum.
. . 2 . 4 5 6 7 8 9	. . . 3 . 5 . 7 . .	50	F A G I L C N P S K	—— fallax.
. . 2 . 4 5 6 7 . .	0 1 . 3	.	F A G I	—— acutangulum.
0 1 2 . 4	0 1 . 3 . 5 6 7 . .	50	. . G I L C N P . K	—— ochroleucum.
. 1 . . ?	. . . .	.	. A G I . . . P . ?	—— suaveolens.
. . . . 7 . .	. . . .	.	. A ? I	—— strictum.
. . . .	. . . .	.	. . . I L C N . . .	—— Ampeloprasum.
. . . .	. . . . 8 .	50	F ? ? I L . . . . K	—— rotundum.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Allium acutiflorum, *Linn.*	1 2	. . . .	. . . .
—— sphærocephalum, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 . 8 .	0 1 2 3 4 . 6 . 8 .
—— vineale, *Linn.*	1 2 3 . . . 7 8 9	. . . .	. . . .
—— oleraceum, *Linn.*	1 2 3 4 5 . . . 9	. 1 . . 4 5 6 . . 9	. . 2 . 4 5 . 7 8 .
—— carinatum, *Linn.?*	. . . . . 6 . 8 9	. 1 2 3 . 5 6 . 8 .	. . 2 . . . . . 8 .
—— montanum, *Sibth. & Sm.*	. . ? 9	. . . .	. . 2 . . . 6 7 8 9
—— Schœnoprasum, *Linn.?*	. . . . 8 .	. . . .	. . . . 7 8 .
—— ——, var. alpinum, *Gaud.*	1 2 . . 5 . . 8 9	. 1 2 3 . . 6 . . 9	. . . . . 5 . . 8 .
Hemerocallis flava, *Linn.*	 9	. . . . 8 .	. . 2 . . . .
—— fulva, *Linn.*	. . . .	. . . .	. . . .
Endymion nutans, *Dumort.?*	. . . .	. . . . . . 6 . . 9	. . . . 7 . .
Muscari comosum, *Mill.*	1 2 . 4 . . 7 8 9	. . . 3 4 5 6 . . 9	. . 2 . 4 . . 7 8 9
—— racemosum, *Mill.*	. 2 . . . . . 8 .	 9	. . 2 . 4 . . 7 8 .
—— botryoides, *Mill.*	. 2 . 4 9	. . . .	. . . . 7 8 .
Bulbocodium vernum, *Linn.*	? ? . . . 6 . 8 .	. . 2 . . . 6 . . .	. . . .
Colchicum autumnale, *Linn.*	1 2 3 4 5 6 . 8 .	. 1 2 3 4 5 6 7 8 9	0 . 2 . 4 5 6 7 8 9
—— alpinum, *DC.*	1 2 . . . 6 7 8 9	0 1 2 3 4 5 6 . 8 .	. 1 . 3 . . . 7 8 .
Veratrum nigrum, *Linn.*	. . . .	. . . .	. . 2 . . . . 7 8 .
—— album, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 8 9
Tofieldia calyculata, *Wahlenb.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (T. palustris, *Huds.*)	. . . . ? .	. . ? . . 5	. . . . 4 5 . 7 8 .
Juncus Jacquini, *Linn.*	1 2 . 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 ?	0 1 2 3 4 5 6 7 8 .
—— conglomeratus, *Linn.*	1 2 . 4 . . 7 8 9	. . . . 4 5 6 . 8 9	0 . . 3 4 . . 7 8 9
—— effusus, *Linn.*	1 2 . . . . 7 8 9	. . . 3 4 5 6 . . 9	0 . 2 . 4 . 6 7 8 .
—— diffusus, *Hoppe*	. . . .	. . . .	. . . . 7 8 .
—— glaucus, *Ehrh.*	1 2 3 4	. . . . 4 . 6 7 8 .	0 . 2 3 4 . 6 7 8 .
—— arcticus, *Willd.*	. . . . 5 . . 8 .	. 1 2 . . 5 . 7 . .	. . . . 7 . .
—— filiformis, *Linn.*	1 2 3 4 . 6 7 8 9	. 1 . . . 5 6 7 8 9	0 1 . 3 4 5 . 7 8 .
—— stygius, *Linn.*	. . . .	. . . .	. . . .
—— triglumis, *Linn.*	1 . . 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 .
—— trifidus, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— capitatus, *Weig.*	. . . 4 . 6 . 8 .	 9	. . . . . . 6 . . .
—— obtusiflorus, *Ehrh.*	1 . . . . . 7 . .	. . . .	. . . . 7 8 .
—— articulatus, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (J. sylvaticus, *Reichard*)	. . . .	 9	. . 2 . . . . 7 8 .
—— ——, var. (J. alpinus, *Vill.*)	. 2 . . . . 7 8 9	0 1 2 . . 5 6 . 8 9	0 1 . 3 4 5 . 7 8 9
—— supinus, *Moench*	. . . .	. . . . . . 6 . . 9	. . 2 . . . 6 7 8 .
—— squarrosus, *Linn.*	. . . .	. . . . . . 6 . . .	. 1 . . . . . 7 . .
—— compressus, *Jacq.*	1 2 . . . . . 8 .	. 1 . . . . 6 . 8 9	. . 2 . . 5 . 7 8 .
—— Tenageia, *Linn. fil.*	 9	 9	0 1 2 . . . .
—— bufonius, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9
Luzula flavescens, *Gaud.*	. . . . 8 .	0 1 2	. . . . . 5 . . 8 .
—— Forsteri, *DC.*	1 2 9	. . . .	. . . . 7 8 .
—— pilosa, *Willd.*	. . . 4 . . . 8 9	. . . . . . 6 7 . 9	. . 2 . 4 5 6 7 8 .
—— sylvatica, *Bichen.*	1 2 3 4 5 6 7 8 9	. 1 2 . 4 5 6 7 8 .	0 . 2 . 4 . 6 7 8 9
—— spadicea, *DC.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9
—— ——, var. (L. glabrata, *Hoppe*)	. . . .	. . . .	? . . . . 8 .
—— albida, *DC.*	. . . .	. . . . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— nivea, *DC.*	1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 . 8 9	. . 2 3 4 5 6 7 8 9
—— pedemontana, *Boiss. & Reut.*	1 2 . . . 6 . . .	. . . .	. . . .
—— lutea, *DC.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 . . 4 5 6 7 8 9
—— campestris, *DC.*	1 2 3 4 5 6 7 8 9	0 1 . 3 . 5 6 7 8 9	0 . 2 . 4 5 6 7 8 9
—— multiflora, *Lej.*	. 2 3 4 . . 7 8 .	. 1 2 3 4 5 6 7 8 .	0 1 . . 4 5 . 7 8 .
—— ——, var. (L. nigricans, *Desv.*)	. 2 . . . . . 8 9	. . . .	. 1 . . 4 . . 7 8 .
—— spicata, *DC.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 . 7 8 .
—— pediformis, *DC.*	1 . . . . . . 8 .	. . . .	. . . .
Cyperus flavescens, *Linn.*	1 2 . . 5 . . 8 9	. . . . . . 6 . 8 9	0 1 2 3 4 . 6 7 8 .

3 0 1 2 3 4 5 6 7 8 9	4 0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . .	. . . .	.	. . . . L	Allium acutiflorum.
. . 2 . 4 5 . 7 8 9	0 1 . 3 4 5 . 7 . .	.	F A G I L C N P . K	—— sphærocephalum.
. . 2 . . 5 6 . 8 .	0 . . 3 . . . 7 8 .	.	F A G I L C N P S K	—— vineale.
. . . 3 . 5 6 7 8 9	. . . 3 . 5 . 7 . .	.	F A G I L C N P S K	—— oleraceum.
. . . 3 4 5 6 7 8 9	0 . . 3 4 5	50	? ? . . . . . P S K	—— carinatum.
. 1 2 . 4 5 . . . 9	0 1 . 3 4 5 6 7 . 9	50	. A G I L C N P . .	—— montanum.
. . . .	. . . .	.	F A . . L ? . P S ?	—— Schœnoprasum.
. . . 3 . . 6 7 . 9	. . . 3 4	.	F A G I . C . P S K	—— ——, var. alpinum.
. . . . ? .	0 . . . . . . 7 . .	.	. A G I . C . . . K	Hemerocallis flava.
. . . . . 5 . 7 8 9	. . . 3	.	. A G . . C . P . ?	—— fulva.
. . . .	. . . .	.	. . . . P . .	Endymion nutans.
0 . 2 3 4 5 . 7 8 .	0 1 2 3 4 . . 7 8 .	50	F A G I L C N P . K	Muscari comosum.
. . . . 4 5 . 7 8 .	0 1 . 3 . . . 7 . .	50	. A G I L C N . . K	—— racemosum.
0 . 2 . 4 5	0 1 2 3	.	? A G I L C N . . K	—— botryoides.
. . . .	. . . .	.	F A	Bulbocodium vernum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	.	F A G I L C N P . K	Colchicum autumnale.
. . . .	. . . .	.	F A . . L C N . . .	—— alpinum.
0 1 . . 4	0 1 2 3 . . . 7 8 .	50	. . G I L C N . . K	Veratrum nigrum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	50	F A G I L C N P S K	—— album.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	.	F A G I L . . P S K	Tofieldia calyculata.
. . . . 8 9	. . . .	.	. A G . . . . . S .	—— ——, var. (T. palustris).
. . . . 4 . 6 7 8 9	. . . 3 . 5	.	F A G I	Juncus Jacquini.
0 . . 3 . . 6 7 8 9	0 1 . 3 4 5 . 7 . .	50	F A G I L C N P S K	—— conglomeratus.
. . . 3 4 5 6 . 8 9	. . . 3 . . . 7 8 .	.	F A G I L C N P S K	—— effusus.
. . . .	. . . .	.	. A G . . ? N P S .	—— diffusus.
0 1 2 3 4 5 6 . 8 9	. 1 . 3 4 5	50	F A G I L C N P S K	—— glaucus.
. . . . 7 8 9	. . . . . 5	.	F A . . . . N ? S .	—— arcticus.
0 . . 3 . . 6 7 8 9	. 1 2 3 4 5 . 7 . .	.	F A G I . C . P S K	—— filiformis.
. . . . 8 .	. . . .	.	. A G . . . . . S .	—— stygius.
0 . . 3 4 5 6 7 8 9	. 1 2 3 4 5	.	F A G I . . N P S K	—— triglumis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I L C N P S K	—— trifidus.
. . . .	. . . .	.	. A G I L C N P S .	—— capitatus.
. . 2 . 4 5 6 . . .	0 1 . 3	.	? A G I L C N P S K	—— obtusiflorus.
0 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 . 9	50	F A G I L C N P S K	—— articulatus.
. . 2 3 4 5 . 7 8 9	0 1 2 3	.	F A G I L C N P S K	—— ——, var. (J. sylvaticus).
0 . . . 4 5 6 7 8 9	. . . 3 4 5	.	F A G I L ? N P S K	—— ——, var. (J. alpinus).
. . . . 7 . .	. . . . 7 . .	.	. A G I . C N P S K	—— supinus.
. . . .	. . . .	.	F A . . . . . P S K	—— squarrosus.
. . 2 . 4 5 . 7 . 9	0 1 . 3 . 5	50	F A G I L C N P S K	—— compressus.
. . . .	. ?	.	F A . I . C . P . K	—— Tenageia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— bufonius.
0 . . . 4 . 6 7 8 9	. . . 3 4 5	50	F A G I . . . P . .	Luzula flavescens.
. . . . 4 5 . 7 . .	0 1 . 3	.	F A G I L C N P . .	—— Forsteri.
0 . 2 3 . . 6 . 8 9	. 1 2 3 4 5 . . 8 .	.	F A G I ? C ? P S K	—— pilosa.
0 . 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— sylvatica.
0 . 2 3 4 5 6 7 8 9	. . 2 3 4 5 . . . 9	.	F A G I . C . P S K	—— spadicea.
. . . . . . 6 7 8 .	. . . .	.	. . G . . . . ? S K	—— ——, var. (L. glabrata).
0 . 2 3 4 5 . 7 8 9	0 1 2 3 4 5 . 7 8 9	50	. A G I L ? . ? . K	—— albida.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	.	F A G I L C . P . K	—— nivea.
. . . .	. . . .	.	. . . . L C . P . .	—— pedemontana.
0 . 2 3 . . 6 7 8 9	. . 2 3	.	F A G . L C . P . .	—— lutea.
0 1 2 3 4 5 6 7 . 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— campestris.
0 . . 3 . 5 6 7 8 9	. . 2 3 4 5 . 7 . .	.	F A G I L C ? P S K	—— multiflora.
. . . . 4 5 . . 8 9	0 . . 3 4 5 . 7 . .	.	? A G . . C N ? . .	—— ——, var. (L. nigricans).
0 . 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 8 9	.	F A G I ? C N P S K	—— spicata.
. . . .	. . . .	.	F . . . . . . P . .	—— pediformis.
. 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 . .	.	F A G I L C N P . K	Cyperus flavescens.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Cyperus fuscus, *Linn.*	1 2 . . . . . 8 9	. . . . . . 6 . . 9	0 1 2 3 4 . 6 7 8 .
—— longus, *Linn.*	. . . . . 6 . 8 .	. . . .	. . 2 . 4 . 6 . . .
—— glaber, *Linn.*	. . . .	. . . . ?	. . . .
—— Monti, *Linn. fil.*	. . . .	. . . .	. . . . 4 . . . . .
—— glomeratus, *Linn.*	. . . .	. . . .	. . . .
Schœnus nigricans, *Linn.*	1 2 . 4 . . 7 8 9	. . . . . . 6 . . 9	0 . 2 . 4 . 6 7 8 9
—— ferrugineus, *Linn.*	. . 3 . . . . 8 .	. . . .	. . . . 7 8 .
Rhyncospora alba, *Vahl*	 9	. . . . . . 6 . . 9	. . 2 . 4 . 6 . 8 .
—— fusca, *Ait.*	. . . .	 9	. . 2 . 4 . . . ? .
Cladium Mariscus, *R. Br.*	. . . . 8 .	 9	. . . . 4 . . . . .
Eleocharis palustris, *R. Br.*	. . . . . . 7 8 .	. . . . . . 6 . 8 9	0 . 2 3 4 . . 7 8 9
—— uniglumis, *Schult.*	. . . .	. . . .	. . . .
—— carniolica, *Koch*	. . . .	. . . . 4 . 6 . . 9	. . . .
—— ovata, *R. Br.*	 9	. . . . . . 6 . . .	. . 2 . 4 . . . . .
—— acicularis, *R. Br.*	. . . . 8 .	. . . . . . 6 . . 9	0 . 2 . . . . 7 8 .
Scirpus cæspitosus, *Linn.*	1 2 3 4 5 . 7 8 9	0 . . . . 5 6 . 8 .	0 1 2 . 4 5 6 7 8 9
—— alpinus, *Schleich.*	. . . . 5 . 7 8 9	. . 2	. . . .
—— pauciflorus, *Lightf.*	1 2 3 4 . . . 8 9	. 1 2 . 4 5 6 . . .	0 1 . 3 4 5 . . 8 .
—— setaceus, *Linn.*	. . . . 8 .	. . . . 8 9	0 1 2 . 4 . 6 7 . .
—— mucronatus, *Linn.*	. . . .	. . . . 4 . 6 . . .	. . 2 . . . . 7 8 .
—— supinus, *Linn.*	. . . . 8 .	 9	. . 2 . 4 . . . . .
—— lacustris, *Linn.*	. . . . . . 7 . .	 9	0 . . . 4 . 6 7 8 .
—— ——, var. (S. Tabernæmontani, *Gmel.*)	. . . .	. . . .	. . . . 8 .
—— triqueter, *Linn.*	 9	. . . .	. . 2 . . . 6 . . .
—— Holoschœnus, *Linn.*	1 2 . . . . . 8 9	 9	. . . . . 5 . 7 8 .
—— maritimus, *Linn.*	. . . .	. . . .	. . . .
—— sylvaticus, *Linn.*	. 2 3 4 5 6 . . .	. . . . . . 6 . . .	. . . . 4 . . 7 8 .
—— Michelianus, *Linn.*	. . . .	. . . . . . 6 . . .	. . 2 . . . .
—— compressus, *Pers.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . . 4 5 . 7 8 9
Fimbristylis dichotoma, *Vahl*	. . . .	 9	. 1 2 . . . .
—— annua, *Roem. & Schult.*	. . . .	. . . .	. . 2 . . . 6 . . .
Eriophorum alpinum, *Linn.*	1 2 3 9	. . 2 . . . 6 . . .	. . . 3 4 5 . 7 8 .
—— vaginatum, *Linn.*	. 2 3 4 . . . 8 .	. 1 2 . . 5 6 . 8 .	0 1 . . 4 . . 7 8 .
—— Scheuchzeri, *Hoppe*	1 2 3 . . . . 8 9	0 1 2 3 . 5 6 7 . .	. 1 . 3 4 5 . . 8 .
—— latifolium, *Hoppe*	1 2 3 4 . . . 8 .	. 1 . . . 5 6 7 . .	. . 2 . 4 5 . 7 8 9
—— angustifolium, *Roth*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 . 7 8 .
Elyna spicata, *Schrad.*	. 2 . . 5 6 . 8 9	0 1 2 3 4 5 6 7 8 .	0 . . . 4 5 . . 8 .
Kobresia caricina, *Willd.*	. . . . 8 9	. . . .	. . . . . 5 . . 8 .
Carex dioica, *Linn.*	. . 3 4 . . . 8 .	. 1 . . . . . . 8 .	. 1 . . . 5 . 7 8 .
—— Davalliana, *Sm.*	1 2 . . . . . 8 9	. . 2 3 . 5 6 . . .	. . 2 . 4 5 6 7 8 .
—— pulicaris, *Linn.*	. . . .	. . . . . . ? . . ?	. 1 . . . . . . 8 .
—— capitata, *Linn.*	. . . .	. . . .	. . . .
—— rupestris, *All.*	. 2 . . . 6 . 8 9	. . . .	0 . . 3 . . . 7 8 .
—— pauciflora, *Lightf.*	. . . .	. . . . . 5	. . . . 8 .
—— microglochin, *Wahlenb.*	. . . . 8 .	. . . .	. . . . . 5 . . 8 .
—— cyperoides, *Linn.*	. . . .	. . . . 8 .	. . . .
—— baldensis, *Linn.*	. . . .	. . . .	. . 2 . 4 . 6 7 8 9
—— curvula, *Linn.*	. . 3 . 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 6 7 8 .
—— incurva, *Lightf.*	. . . . 8 9	. . . 3 . 5 . 7 . .	? 1 . . . . . . 8 .
—— stenophylla, *Wahlenb.*	. . . .	. . . .	. . . . . . 6 . . .
—— disticha, *Huds.*?	. . . . ? .	. . . .	. . . .
—— fœtida, *All.*	1 . 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 . . . 7 8 .
—— microstyla, *J. Gay*	. . . .	. . . 3 . . . . 8 .	. . . .
—— vulpina, *Linn.*	1 2 . . . . 7 8 9	. . . 3 4 5 6 . . 9	. . . . 7 8 .
—— muricata, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . . 4 5 6 7 8 9
—— divulsa, *Good.*	1 2 . 4 9	. . . . . 5 6 . 8 9	. . 2 . 4 5 . 7 8 .
—— teretiuscula, *Good.*	. . . .	. . . .	. . . .
—— paniculata, *Linn.*	1 2 3 . . . 7 8 9	. . . . . 5 6 7 8 9	. . 2 . 4 . 6 7 . .
—— ——, var. (C. paradoxa, *Willd.*)	. . . .	. . . . 4	. . . .
—— Schreberi, *Schrank*	. . . .	. . . . . . ? . . 9	. 1 . . . . . 7 8 .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . 2 3 4 5 . 7 8 9	0 1 2 3 4 5 . 7 . .	.	F A G I L C N P S K	Cyperus fuscus.
. . 2 . . 5 . 7 . .	0 . . 3 . . . 7 . .	.	. . G I L C N ? . .	—— longus.
. . . . 4	0	.	. . . I . . N . . .	—— glaber.
. . . . 4 5 6 7 . .	. . . .	.	F . . I L C N . . .	—— Monti.
. . . . 4 5	. . . 3	.	. . G . . C N . . .	—— glomeratus.
0 1 2 3 4 5 . 7 8 9	. 1 2 3 . 5 . 7 8 .	50	F A ? I L C N P S K	Schœnus nigricans.
. . . . . 5 . 7 8 9	. . . .	50	F A G . . . . . S K	—— ferrugineus.
. . . . . 5 . . 8 9	. . . 3	.	F A G ? L C ? P S K	Rhyncospora alba.
. . . . ?	. . . .	.	. A ? . . C . P S .	—— fusca.
. . 2 . 4 . . . 8 .	. . . .	.	. A ? I L C N . S K	Cladium Mariscus.
0 1 . 3 4 5 6 7 8 9	0 1 . 3 4 . . 7 . .	50	F A G I L C N P S K	Eleocharis palustris.
. . . . . 5 . 7 8 9	. . . 3	.	F A G . ? . . P S .	—— uniglumis.
. . . .	. . . .	.	. . . I . . . . . K	—— carniolica.
. . . .	. . . .	.	. A ? I . . . . . K	—— ovata.
. . . . 4 5	. . . .	.	F A G ? . C . P S K	—— acicularis.
0 . . 3 4 5 6 7 8 9	. . 2 3 4 5	.	F A G ? ? . . P S K	Scirpus cæspitosus.
?	. . . .	.	. A	—— alpinus.
0 1 . 3 . 5 6 7 8 9	. . . 3 4 5 . . . 9	50	F A G ? ? . N P S K	—— pauciflorus.
. . . . 7 8 9	. . . .	50	F A . . L C . P S K	—— setaceus.
. . . . . 5	. . . 3	50	F A G I . C	—— mucronatus.
. . . .	. . . .	.	. ? . I . C . . . K	—— supinus.
. . 2 . 4 5 . . . 9	0 . . . . . . 7 8 .	50	F A G I L C N P S K	—— lacustris.
. . 2 . . 5 . 7 . .	. . . .	.	F A . I L . . P S K	—— ——, var. (S. Tabernæmontani).
0 . . . . 5	. . . . 8 .	.	F A . I . C . . S K	—— triqueter.
. 1 2 . 4 5	0 . . 3	.	F . G I L C N P . .	—— Holoschœnus.
. . 2 . ? 5 . 7 . .	. . . . 4	.	F A ? I L C N P S K	—— maritimus.
0 . . 3 . 5 6 7 8 9	0 . . 3 4 . . 7 8 .	50	F A G I L C N P S K	—— sylvaticus.
. . . .	. . . .	50	. . G I . C N . . ?	—— Michelianus.
0 . 2 3 4 . 6 7 8 9	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— compressus.
. . . . 4	. . . .	.	. . . . . L C N . . .	Fimbristylis dichotoma.
. . . . 7 . .	?	.	. . . . . C	—— annua.
. . . 3 . 5 6 7 8 9	. . . 3 4 5 . 7 . .	.	. A G . . C . P S K	Eriophorum alpinum.
0 . . 3 . . 6 7 8 9	. . 2 3 4	.	. A G . . . . . S K	—— vaginatum.
. . . 3 . 5 6 7 8 9	. . . 3 9	.	F A G . L C . . S .	—— Scheuchzeri.
0 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 . .	50	F A G I L C N P S K	—— latifolium.
0 . 2 3 4 5 6 7 8 9	. . 2 3 4 5 . 7 . .	50	F A G I L C N P S K	—— angustifolium.
. . . 3 4 5 6 7 8 9	. . . . 4 . . 7 . 9	50	F A G I . . N P S .	Elyna spicata.
. . . 3 . . 6 7 8 9	. . . 3 4 5	.	. A G . . . . . S .	Kobresia caricina.
. . . . . 5 . . 8 9	. . . 3 4 5 . 7 . .	.	. A G . . . . ? S K	Carex dioica.
. . . 3 4 . 6 . 8 9	0 . 2 3 4 5 . 7 . .	.	F A G I L C N P . K	—— Davalliana.
. . . . 7 8 .	. . . .	.	F A G . . . . P S K	—— pulicaris.
. . . . 8 .	. . . .	.	. . G . . . . . S .	—— capitata.
. . 2 . . . . 7 8 9	. . . 3 4 9	.	F A G I . . . P S ?	—— rupestris.
0 . . . . . 6 . 8 9	. . . 3 . . . ? . .	.	F A G . . . . . S K	—— pauciflora.
. . . . . . 6 . 8 9	. . . .	.	. A G . . . . . S .	—— microglochin.
. . . .	. . . .	.	. . G . . C . . . K	—— cyperoides.
0 1 2 3 4 5 . . . 9	. . . 3 . 5 . 7 . .	.	. A G	—— baldensis.
0 . . 3 . . 6 7 8 9	. . . 3 4 5 . . . 9	.	F A G I . . . P . K	—— curvula.
. . . . 8 .	. . . .	.	. A . . . . . . S .	—— incurva.
. . . . 7 . .	. . . .	.	. . G I . . . . S K	—— stenophylla.
. . . . 9	. . . 3	.	? A G ? . . ? P S K	—— disticha.
0 . 2 3 . . 6 7 8 .	. . . .	.	F A G . . . . P . .	—— fœtida.
. . . .	. . . .	.	. A G	—— microstyla.
0 . 2 . 4 5 . . . 9	0 1 2 3 9	50	F A G I L C N P S K	—— vulpina.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— muricata.
0 1 . . 4	0 . . 3 4 5 . 7 . .	50	F A G I L C N P S K	—— divulsa.
. . . . . 5 . . . 9	. . . 3	.	. A G . . . . . S K	—— teretiuscula.
0 . . 3 . 5 6 . 8 .	0 . . 3 4 5 . 7 . 9	.	F A G I L C N P S K	—— paniculata.
. . . .	. . . 3	.	. A G . . . . . S K	—— ——, var. (C. paradoxa).
. . . . 4 5	0 1 . 3	.	. A ? I L C ? . S K	—— Schreberi.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Carex brizoides, *Linn.*	. . . . . 6 . 8 .	. . . . 4 . 6 . . .	. . 2 . 4 . ? . . .
—— remota, *Linn.*	? 7 8 9	. . . . 4 . 6 . . .	. . 2 . 4 . 6 7 8 .
—— echinata, *Murr.*	1 2 3 . 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .
—— leporina, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— elongata, *Linn.*	. 2 9	. . . . . . 6 . . 9	. . . . . . 6 . . .
—— lagopina, *Wahlenb.*	. . . . 8 .	. . 2 3 4 5 6 7 8 .	0 1 . . 4 5 . . 8 .
—— Heleonastes, *Ehrh.*	. . . .	. . . .	. . 2 . . . .
—— canescens, *Linn.*	1 2 3 4 . . . 8 9	. . . . 4 5 6 7 8 .	0 . . 3 4 5 6 . . .
—— Persoonii, *Sieber.*	. . . .	. . . . . 5 6 . . .	. . . . 8 .
—— mucronata, *All.*	. 2 . . . . 7 8 9	 9	. . 2 . . 5 6 7 . .
—— stricta, *Good.*	. . . . . . 7 8 9	 9	. . 2 . 4 . 6 7 8 .
—— Goodenowii, *J. Gay*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .
—— acuta, *Linn.*	. . . . 8 9	. . . . . . 6 . . 9	. . 2 . 4 . 6 7 8 .
—— bicolor, *All.*	. . . . 8 .	. 1 . . . 5 6 . 8 .	. . . . . 5 . . 8 .
—— Buxbaumii, *Wahlenb.*	. . . .	. . . .	. . . .
—— fuliginosa, *Schkuhr*	. . . .	. . . .	. . . .
—— Vahlii, *Schkuhr*	. . . .	. . . .	. . . .
—— nigra, *All.*	1 . . 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 .	. 1 . 3 4 5 . . 8 .
—— atrata, *Linn.*	1 2 . . 5 . . 8 .	. 1 2 . . 5 6 . 8 9	0 1 . 3 4 5 . 7 8 9
—— ——, var. (C. aterrima, *Hoppe*)	. . . .	. . . 3	. . . . . 5 . . 8 .
—— irrigua, *Sm.*	. . . .	. . . . . . 6 . . 9	. 1 . . . . . 7 8 .
—— limosa, *Linn.*	. . . . 8 .	. . . . 8 .	. . . . 7 8 .
—— supina, *Wahlenb.*	. . . .	. . . .	. . . .
—— pilulifera, *Linn.*	. . . . 8 .	. . . .	. . . . 7 8 .
—— tomentosa, *Linn.*	. . . . 8 .	. . . .	. . . . 7 8 .
—— montana, *Linn.*	 9	. . . .	. . 2 . 4 . 6 7 8 9
—— ericetorum, *Pollich*	. 2 . . . . . 8 9	0 . 2 . . 5 6 . . .	. . . . 4 5 . 7 8 .
—— præcox, *Jacq.*	1 2 3 4 . . 7 8 9	0 . 2 . . 5 6 7 8 9	. . 2 . 4 5 6 7 8 9
—— polyrhiza, *Wallr.*	 9	. . . .	. . . . 7 8 .
—— humilis, *Leyss.*	. 2 . . . 6 7 8 9	. . . . 4 . 6 . . .	. . . . . . 6 7 8 9
—— Halleriana, *Asso*	. 2	. . . . . 5 6 . . .	. . . . 7 8 9
—— digitata, *Linn.*	. 2 . . . . 7 8 9	. . . . 7 . 9	. . 2 . 4 . 6 7 8 9
—— reclinata, *Facch.*	. . . .	. . . .	. . . .
—— ornithopoda, *Willd.*	1 2 3 4 5 . 7 8 .	. . 2 . . . 6 . . .	0 . . . 4 5 . 7 8 .
—— pediformis, *C. A. Mey.*	. . . .	. . . .	. . . .
—— alba, *Scop.*	. . . .	. . . .	. . 2 . . 5 6 7 8 9
—— nitida, *Host*	. . . . 8 .	. . . .	. 1 . . . . . 7 . .
—— pilosa, *Scop.*	. . . . . 6 . 8 9	. . . .	. . 2 . 4 . 6 7 8 .
—— panicea, *Linn.*	1 2 3 4 . . 7 8 9	0 . . . 4 5 6 7 8 9	0 . . . 4 5 . 7 8 .
—— glauca, *Scop.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— maxima, *Scop.*	1	. . . . . . 6 . . 9	. . 2 . . . 6 7 8 .
—— strigosa, *Huds.*?	. . . .	. . . . . . 6 . . .	. . . . 8 .
—— pallescens, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9	0 1 2 . 4 5 . 7 8 9
—— capillaris, *Linn.*	. . . . 5 6 7 8 9	. . 2 . . 5 6 . 8 9	. . . . . 5 6 7 8 .
—— frigida, *All.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 8 .
—— sempervirens, *Vill.*	1 2 . . 5 . 7 8 9	0 1 2 . 4 5 6 7 8 9	0 1 . 3 4 5 . 7 8 9
—— firma, *Host*	. . . . ? .	. . . .	. . 2 . . 5 6 7 8 9
—— ferruginea, *Scop.*	1 2 3 4 5 6 . 8 9	. . 2 . . 5 6 7 . .	. . 2 . 4 5 6 7 8 .
—— tenuis, *Host*	. . . .	. . . .	. . . . 8 .
—— hispidula, *Gaud.*	 9	. . . . . 5	. . . .
—— Michelii, *Host*	. . . .	. . . .	. . 2 . . . 6 . . 9
—— flava, *Linn.*	. 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9
—— ——, var. (C. Oederi, *Ehrh.*)	1 . . . . . 7 8 9	. 1 . . . 5 6 . . 9	0 . 2 . 4 . 6 7 8 .
—— fulva, *Good.*?	. . . . 8 9	. ?	. . . . 7 8 .
—— distans, *Linn.*	1 2 . . . . . 8 9	. . . . 4 9	0 . 2 . . 5 6 7 8 .
—— punctata, *Gaud.*	 9	 9	. . 2 . . . . . 8 .
—— sylvatica, *Huds.*	1 2 . . . . 7 8 9	. . . . . 5 6 . 8 9	0 . . . . . 6 7 8 9
—— Pseudo-cyperus, *Linn.*	. . . .	. . . .	. . 2 . . . . 7 8 .
—— ampullacea, *Good.*	1 . 3 . . . . 8 .	. . . . . 5 6 . . .	. . . . . 5 . . 8 .
—— vesicaria, *Linn.*	. . . . . . 7 8 9	. . . . . . 6 . . 9	. 1 2 . . . . 7 8 .
—— paludosa, *Good.*	1 . . . . . . 8 .	. . . . . . 6 . . 9	. . 2 . 4 . . 7 8 .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . . . 5	. . . 3 . . . . 8 .	.	F A ? . . C . P . K	Carex brizoides.
0 . . 3 4 5 . 7 . 9	0 1 . 3 4 . . 7 8 .	50	F A G I L C N P S K	—— remota.
0 . 2 3 4 5 6 7 8 9	. . 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— echinata.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	50	F A G I L C N P S K	—— leporina.
. . . 3 9	0	.	. A G I . . . . S K	—— elongata.
. . . . . . 6 7 8 .	. . . .	.	. A G . . . . . S K	—— lagopina.
. . . .	. . . . 7 . .	.	. A G . . . . . S .	—— Heleonastes.
0 . . 3 . . 6 7 8 9	. . . 3 4 5 . 7 . .	50	F A G ? ? C N ? S K	—— canescens.
0 9	. . . .	.	F A G I . . . . S .	—— Persoonii.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I . C N . . K	—— mucronata.
0 . . . 4 5 . 7 8 .	. . . 3 9	50	F A G I L C . P S K	—— stricta.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	50	F A G I L C N P S K	—— Goodenowii.
. . . . 4 5 . . . 9	. . . 3 . . . 7 . .	.	F A G I L C N P S K	—— acuta.
. . . . 7 8 .	. . . .	.	F A G ? . . . . S .	—— bicolor.
. . . . . 5 . 7 8 .	. . . .	.	F A G . . . . . S .	—— Buxbaumii.
. . . .	 9	.	. . . .	—— fuliginosa.
. . . . 7 . .	. . . .	.	. A . . . . . . S .	—— Vahlii.
. . 2 3 4 5 6 7 8 9	. . 2 . 4 9	50	F A G I . . N P S .	—— nigra.
0 . 2 3 4 5 6 7 8 9	. . 2 3 4 5 . 7 . 9	50	F A G I . . . P S K	—— atrata.
. . . . . . 6 7 8 .	. . . . 4 5 . . . 9	.	? A G . . . . . . K	—— ——, var. (C. aterrima).
. . . 3 . . . 7 8 9	. . . . 4	.	. A G . . . . . S .	—— irrigua.
0 . . . . 5 6 7 8 9	. . . .	.	F A G ? . . . P S K	—— limosa.
. . . . 7 . .	. . . .	.	. . G . . . . . S ?	—— supina.
0 . . 3	. . . 3 . . . 7 . .	50	F A G I . C . P S K	—— pilulifera.
. . . . 4 5 . . 8 .	. . . 3 4	.	F A G I . C . P S K	—— tomentosa.
. . . 3 4 5 . 7 8 9	0 . 2 3 . . . 7 . .	50	F A G I L . . P S K	—— montana.
. . . . 4 . . 7 8 9	. . . 3	.	. A G . . . . P S K	—— ericetorum.
0 1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— præcox.
. . . . . 5 . . 8 9	. . . 3	.	? A G . . . . ? . .	—— polyrhiza.
. . . 3 4 5 . 7 8 .	0 1 . 3 . . . 7 8 .	50	F A G I L C N P . K	—— humilis.
. 1 . . 4 5	0 1 . 3 . . . . 8 .	50	F A G I L C N P . K	—— Halleriana.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . . 7 8 .	50	F A G I L C ? P S K	—— digitata.
. . . . 8 9	. . . . . 5 . 7 . 9	.	. . . .	—— reclinata.
0 . . 3 4 5 . 7 8 9	. 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— ornithopoda.
. . . .	. . . . 4	.	. . . . S .	—— pediformis.
. . . . 4 5 . . 8 9	0 1 . 3 4 5 . 7 8 .	50	F A G I . . . . . K	—— alba.
. . . . 4 5 . 7 . 9	. . . 3	50	F A G I . C . . . K	—— nitida.
. . . .	. . . .	50	F A G I L C . . . K	—— pilosa.
0 . . 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 . 9	50	F A G I L C ? P S K	—— panicea.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— glauca.
0 . . . 4 . . . 8 .	0 . . 3 4 . . . 8 .	50	F A G I L C N P . K	—— maxima.
. . . .	. . . .	.	. A . . . C N . . ?	—— strigosa.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . .	50	F A G I L C N P S K	—— pallescens.
0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	50	F A G I . . . ? S K	—— capillaris.
0 1 2 3 . . 6 7 8 9	. . . 3 4 5 . 7 . 9	.	F A G I L C N P S K	—— frigida.
0 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 6 7 . 9	.	F A G I L C N P . K	—— sempervirens.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	.	F A G I . C . . . K	—— firma.
. 1 2 . 4 5 . . 8 9	. 1 2 3 4 5 . 7 8 9	50	F A G I L C . ? S K	—— ferruginea.
0 . 2 . 4 5 . . . 9	0 1 2 3 4 5 6 7 8 9	50	F A G I . . . P . K	—— tenuis.
. . . .	. . . .	.	. . . .	—— hispidula.
. . 2 3 4 5 . 7 . 9	0 . . 3	50	. . G I . C N . . K	—— Michelii.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— flava.
0 . . 3 4 5 . 7 8 9	0 . . . . 5 . 7 . 9	.	F A G ? L C N P S K	—— ——, var. (C. Oederi).
. . . . . 5 . 7 8 .	. . . 3 4	.	F A G . . C . P S K	—— fulva.
0 . 2 . 4 5 . 7 8 .	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— distans.
. . . .	. . . .	.	. . G . L . N . S .	—— punctata.
. 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— sylvatica.
. . . . 4 5 . 7 . .	0 . . . . . . 7 . .	.	F A G I . C N P S K	—— Pseudo-cyperus.
0 . . . 4 5 6 7 8 9	. . 2 3 . 5 . . . 9	.	F A G I L C N P S K	—— ampullacea.
. . . . 4 5 . 7 8 9	. . . 3 . 5 . 7 . 9	50	F A G I ? C N P S K	—— vesicaria.
. . . 3 4 5 . 7 8 .	0 . . 3	.	F A G I L C N P S K	—— paludosa.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Carex riparia, *Curt.*	 9	. . . .	. . 2 . 4 . 6 7 8 .
—— nutans, *Host*	. . . .	. . . .	. . . .
—— filiformis, *Linn.*	. . . . ? .	. . . .	. . . . 8 .
—— hirta, *Linn.*	1 2 . 4 . . 7 8 9	. . . . . . 6 7 . 9	. . 2 . 4 5 6 7 8 9
Andropogon Ischæmum, *Linn.*	1 2 3 4 . 6 . 8 9	. . 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 .
—— distachyos, *Linn.*	1 2	. . . .	. . 2 . . . .
—— Gryllus, *Linn.*	? 8 9	. . . . . . 6 . . 9	0 . 2 3 4 . 6 7 8 9
Heteropogon Allionii, *Roem. & Schult.*	. 2 . . . . . 8 .	. . . . 4 9	. . 2 . . . 6 . 8 .
Sorghum halepense, *Pers.*	1 9	. . . .	. . 2 . 4 . . 7 . .
Tragus racemosus, *Desf.*	1 2 . . . . . 8 9	. . . .	. . 2 . . . 6 7 8 .
Panicum sanguinale, *Linn.*	1 2 . 4 . . 7 8 9	. . . . . . 6 7 8 9	0 1 2 3 4 5 6 7 8 .
—— ——, var. (P. ciliare, *Retz*)	. . . .	 9	. . 2 . . . . 7 8 .
—— glabrum, *Gaud.*	. . . . . . 7 . .	. . . . . . 6 . 8 .	0 . 2 . . . . 7 8 .
—— Crus-galli, *Linn.*	1 2 . 4 . . . 8 9	. . . . 4 . 6 . . 9	0 1 2 3 4 . 6 7 8 .
—— undulatifolium, *Ard.*	. . . . 8 .	. . . . . . 6 . 8 9	. . 2 3 4 . . 7 . .
Setaria verticillata, *Beauv.*	1 2 . . . . . 8 .	. . . . 4 5 6 . . 9	0 1 2 3 4 5 6 7 8 .
—— viridis, *Beauv.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— glauca, *Beauv.*	1 2	. . 2 . 4 . 6 . . 9	. . 2 . . . . 7 8 .
Phalaris arundinacea, *Linn.*	1 2 . . 5 . . 8 9	. . . .	0 . 2 . 4 . 6 7 8 .
Hierochloë borealis, *Roem. & Schult.*	. . . .	. . . .	. . . .
—— australis, *Roem. & Schult.*	. . . .	. . . .	. . . . . . 6 7 8 .
Anthoxanthum odoratum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Alopecurus pratensis, *Linn.*	1 2 . . . . . 8 9	. . . . . . 6 . 8 9	. . . . 7 8 .
—— agrestis, *Linn.*	1 2 . . . . 7 8 9	. . . . . . 6 . . 9	. . 2 . 4 5 6 7 8 9
—— geniculatus, *Linn.*	. 2 . . . . 7 8 9	. . . . . . 6 . . 9	. . 2 . 4 . 6 7 8 .
—— utriculatus, *Pers.*	. . . .	. . . . . . 6 . . 9	. . . . 4 . . 7 . .
—— Gerardi, *Vill.*	1 2 3 4 5 6 7 8 .	0 . 2 . . . . . 8 .	. . 2 . . . .
Phleum tenue, *Schrad.* ?	. . . .	. . . .	. . 2 3 . . . . . .
—— Michelii, *All.*	1 2 3 4 . . . 8 .	0 . 2 . 4 . 6 . 8 .	0 . . . 4 . . . 8 .
—— Boehmeri, *Wibel*	1 2	. 1 2 3 4 5 6 7 8 .	0 . 2 3 4 5 . 7 8 .
—— asperum, *Vill.*	1 . . 4 . 6 . 8 .	. . . . . . 6 . . .	. . 2 . 4 5 . 7 8 9
—— pratense, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— alpinum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— echinatum, *Host*	. . . .	. . . .	. . . .
Chamagrostis minima, *Bork.*	. . . .	. . . . . . ? . . ?	. . . . 4 5 . . . .
Cynodon Dactylon, *Pers.*	1 2 3 4 . . 7 8 9	. . . . 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9
Leersia oryzoides, *Soland.*	. . . . . 6 . 8 9	. . . . . . ? . . .	. . . .
Coleanthus subtilis, *Seid.*	. . . .	. . . .	. . . .
Polypogon monspeliensis, *Desf.*	. . . .	. . . .	. . . .
Agrostis stolonifera, *Linn.*	1 2 . . . . 7 8 9	0 1 2 . 4 5 6 . 8 9	. . 2 . 4 5 6 7 8 .
—— vulgaris, *With.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— canina, *Linn.*	1 2 3 . . . . 8 .	. . . . 4 . 6 7 . .	0 1 2 3 4 . 6 7 8 .
—— alpina, *Scop.*	1 2 . . 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	. 1 . . 4 5 . . 8 .
—— rupestris, *All.*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9
Apera Spica-venti, *Beauv.*	. . 3 4 . . 7 8 9	0 . 2 . . . 6 . . 9	. . 2 . 4 5 6 7 8 .
—— interrupta, *Beauv.*	. . . .	. . . . 4 . . . . ?	. . 2 . 4 . 6 . . .
Calamagrostis lanceolata, *Roth*	. . . .	. . . .	. . . . ? ? .
—— littorea, *DC.*	. . . . . 6 . . .	 9	0 1 2 . 4 5 . . . .
—— epigeios, *Roth*	1 . . . . . . 8 .	 9	. . . . 7 8 .
—— Halleriana, *DC.*	1	. . 2 . . 5	. . . . 8 .
—— tenella, *Host*	1	. . . 3 9	0 . . . . . . 7 8 .
—— varia, *Beauv.*	. . 3 . 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (C. acutiflora, *DC.*)	. . . .	. . . .	. . . .
—— sylvatica, *DC.*	1 2 . . . 6 7 8 9	. . . . . . 6 . . ?	. . . . 4 5 6 7 8 9
Milium effusum, *Linn.*	1 2 3 . . . 7 8 .	. . . . ?	. . . . 4 5 . . . .
Piptatherum multiflorum, *Beauv.*	. . . .	. . . .	. . . .
—— paradoxum, *Beauv.*	. . . .	. . . .	. . . .
Stipa pennata, *Linn.*	1 2 3 4 . . 7 8 9	. . 2 3 4	. . 2 . . . 6 7 8 .
—— capillata, *Linn.*	. . . . 8 .	. . . . 4	. . . . . 5 . . . .
—— Aristella, *Linn.*	. 2	. . . .	. . . .

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . . 4 5	0 1	.	F A G I L C N P S K	Carex riparia.
. . . . 4 . . . 8 .	. . . . 7 . .	.	. . G . . . . . . K	—— nutans.
. . 2 . . 5 . . 8 .	. . . .	.	. A G . . . . . S K	—— filiformis.
0 1 . . 4 5 6 7 8 9	0 1 . 3 4 . . 7 8 9	50	F A G I L C N P S K	—— hirta.
0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9	50	F A G I L C N P . K	Andropogon Ischæmum.
. . . .	. . . .	.	. . . I L C N . . .	—— distachyos.
0 1 2 . 4 5 . 7 . .	0 1 2 3 4 5 6 7 8 9	50	. . . I L C N . . K	—— Gryllus.
0 1 2 . 4 . . 7 8 .	. . . 3	.	. . . I L . N . . .	Heteropogon Allionii.
. . 2 . 4 5	0 1	.	. . . I L C N P . .	Sorghum halepense.
. . 2 . 4 5 . 7 8 .	0 . . 3	50	F A . I L C N P . .	Tragus racemosus.
. . . 3 4 5 . . 8 9	0 . . . . . . 7 8 .	.	F A G I L C N P . K	Panicum sanguinale.
. . . . 4 5 . . 8 .	. . . 3	.	. . G I . C N . . K	—— ——, var. (P. ciliare).
. . . . . 5 . . 8 .	. . . 3	.	F A G I L C N P S K	—— glabrum.
0 . 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— Crus-galli.
. 1 . . 4 5 . . 8 .	. 1 . 3 . . . 7 . .	50	. . . I	—— undulatifolium.
0 . 2 . 4 5 . 7 8 .	0 1 . 3 4 5 . 7 8 .	50	F A ? I L C N P ? K	Setaria verticillata.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— viridis.
. . . . 4 5 . 7 8 9	0 1 . . . . . 7 8 .	.	F A G I L C N P . K	—— glauca.
. . 2 . 4 5 . . 8 .	0 . . 3	50	F A G I ? C N P S K	Phalaris arundinacea.
. . . . 8 9	. . . .	.	F . . . . S K	Hierochloë borealis.
0 1 . 3 4 5 . 7 8 9	0 1 . 3 . . . 7 . .	50	. ? G ? . . . . S K	—— australis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	Anthoxanthum odoratum.
. . 2 . 4 . . 7 8 .	. . . . 7 . .	50	F A G I ? C N P S K	Alopecurus pratensis.
0 1 2 3 . 5 . 7 8 .	0 1 2 3 . 5 . 7 8 9	50	F A G I L C N P S K	—— agrestis.
. . . . . 5 . . 8 9	0 . . 3	50	F A G I ? C N P S K	—— geniculatus.
. . . . 4	. . . 3	.	. . G I L C N P . .	—— utriculatus.
. . . .	. . . .	.	F . . ? L C N P . K	—— Gerardi.
. . . .	. . . .	.	. . G I . C N . . .	Phleum tenue.
. . . . 4	0 . . 3	.	F A G I L C N . . K	—— Michelii.
. 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5	.	F A G I ? C N P S K	—— Boehmeri.
. . . . 4 5 . . 8 9	0 . . 3	50	F A G I L C N . . .	—— asperum.
0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 7 . 9	50	F A G I L C N P S K	—— pratense.
0 1 2 3 4 5 6 7 8 9	. 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— alpinum.
. . . .	?	.	. . . I	—— echinatum.
. . . .	. . . .	.	F . . . . . N P . .	Chamagrostis minima.
0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 .	50	F A G I L C N P . K	Cynodon Dactylon.
. . 2 . . 5 . 7 . .	. . . 3	.	F A ? I L C . P S K	Leersia oryzoides.
. . . . 8 .	. . . .	.	. . . . S .	Coleanthus subtilis.
. . . .	. . . .	50	. A . I L C N . . .	Polypogon monspeliensis.
. . . 3 4 5 . 7 8 9	. 1 . 3 4 5 . 7 8 .	.	F A G I L C N P S K	Agrostis stolonifera.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	50	F A G I L C N P S K	—— vulgaris.
. . . 3 4 5 . . 8 .	0 1 . . . . . 7 . .	.	F A G I L C N P S K	—— canina.
0 . 2 . 4 5 6 7 8 9	. . . 3 4 5 . 7 . 9	.	F A G I ? . . P S K	—— alpina.
0 . 2 3 4 . 6 7 8 9	. 1 2 3 4 5 . 7 . 9	.	F A G I L C ? P S K	—— rupestris.
0 . 2 3 4 5 . 7 8 9	0 1 . 3 4 5 . 7 . 9	50	F A G ? L . . P S K	Apera Spica-venti.
. . . . 4	0	.	F A . I . . N . . K	—— interrupta.
. . . .	. . . 3	.	. A G . . . . . S K	Calamagrostis lanceolata.
. . . 3 4 5 . 7 8 9	. . . 3 4	.	F A G I . ? . . S .	—— littorea.
0 . 2 . 4 5 . 7 8 9	0 . . 3 4 . . 7 . .	50	F A G I L C N P S K	—— epigeios.
. . . 3 . 5 6 7 8 9	. . . 3	.	F A G I . . . . S K	—— Halleriana.
. . . ? . . . 7 8 9	. . . 3	.	F A G . . C . . . K	—— tenella.
. 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . .	50	F A G I L C N . S K	—— varia.
. . . . 9	. . . 3	.	F A G . ? ? . . S K	—— ——, var. (C. acutiflora).
. . . . 4 5 6 . 8 9	0 1 2 3 4 5 . . 8 .	50	? A G I L ? N P S K	—— sylvatica.
. . . 3 4 5 6 7 .	0 . . 3 . 5 . . 8 .	.	F A G I L C N P S K	Milium effusum.
0 . 2	0	.	F . . I L C N P . .	Piptatherum multiflorum.
. . . .	. . . .	50	. . . I . . N P . .	—— paradoxum.
0 1 2 . 4 5 . 7 8 .	0 1 2 3 . . . 7 8 .	50	F A G I L C N P S K	Stipa pennata.
. . 2 . . 5 . 7 8 9	. . . .	.	F A G I . . N . . K	—— capillata.
. . . .	. . . . 8 .	50	. . . I L C N P . .	—— Aristella.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Lasiagrostis Calamagrostis, *Link*	1 2 3 4 . . . 8 9	. 1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Phragmites communis, *Trin.*	1 2 . . 5 6 7 8 9	0 . . . 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 .
Sesleria cærulea, *Ard.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 .	. 1 2 . 4 5 6 7 8 9
—— argentea, *Savi*	1 2 . . . . . 8 .	. . . .	. . . .
—— ——, var. (S. elongata, *Host*)	. . . .	. . . .	. . . . ? . . . . .
—— microcephala, *DC.*	. . . .	. . . .	. . . . . 5 . . 8 9
—— sphærocephala, *Ard.*	. . . .	. . . .	. . . . . . 6 7 . .
—— disticha, *Pers.*	. . . . 8 .	. . . .	. . 2 3 4 5 6 7 8 .
—— ——, var. (S. pedemontana, *Reut.*).	1 2 3 . 5 6 . 8 .	. . . .	. . . .
Koeleria cristata, *Pers.*	1 . 3 4 . . 7 8 9	0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. ciliata, *Parl.*	. 2 . . . . . . ?	. . . .	. . . .
—— valesiaca, *Gaud.*	. . . . . 6 . 8 9	. 1 2	. . . .
—— ——, var. (K. setacea, *DC.*)	1	. 1 . 3	. . . .
—— phleoides, *Pers.*	1 2	. . . .	. . . .
Aira cæspitosa, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— flexuosa, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Holcus lanatus, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— mollis, *Linn.*	1 2 . . . . . 8 9	. . . . 4 . 6 . . 9	. . 2 . 4 . 6 7 8 9
Arrhenatherum elatius, *Beauv.*	1 2 3 4 . . 7 8 9	0 . 2 3 4 5 6 7 8 9	. . 2 3 4 5 6 7 8 9
Avena fatua, *Linn.*	. 2	. . . . . . 6 . . .	. . 2 . 4 5 6 7 8 .
—— pubescens, *Linn.*	1 2 . . . . . 8 .	. . 2 . . . . . . ?	. . . . 7 8 9
—— ——, var. (A. lucida, *Bert.*)	. . . .	. . . .	. . 2 3 . . . . 8 .
—— ——, var. (A. amethystina, *DC.*).	. . . . 5 . . 8 .	. . . .	. . . . 8 .
—— pratensis, *Linn.*	1 2 . . . . 7 8 .	. . . . . . 6 . 8 9	. . . . 4 5 . 7 8 9
—— Scheuchzeri, *All.*	. 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 .	0 1 . 3 4 5 . . 8 9
—— sempervirens, *Vill.*	1 2	. . . .	. . . .
—— setacea, *Vill.*	. 2 . . ? . . ? .	. . . .	. . . .
—— montana, *Vill.*	1 . 3 . ? 6 . 8 .	. . . .	. . . .
—— Hostii, *Boiss.*	1 2 . . . 6 . 8 .	. . 2 . . 5	. . . . . . 6 . 8 9
—— tenuis, *Moench*	. . . .	. . . .	. . . .
—— flavescens, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (A. alpestris, *Host*)	. . . .	. . . .	. . . . . 5 . . 8 9
—— distichophylla, *Vill.*	. . . . . 6 . 8 .	0 1 2 3 . 5 6 7 . .	. . . . . 5 . . 8 .
—— argentea, *Willd.*	. . . .	. . . .	. . 2 . . 5 6 7 8 9
—— subspicata, *Clairv.*	. . . . 5 . . 8 .	. . . . . 5 6 7 . .	. . . 3 4 5 6 . 8 .
—— Gaudiniana, *Ambrosi*	. . . . 8 .	. 1 . . 4 . ? . . ?	. . . .
—— caryophyllea, *Wigg.*	1 2 . . . . 7 8 9	. . . . . . 6 . . .	0 . 2 . 4 . 6 7 8 .
—— capillaris, *Mert. & Koch*	. . . .	. . . .	. . 2 . 4 . . 7 8 .
—— ——, var. (A. ambigua, *De Not.*)	. . . .	. . . .	. . . .
—— præcox, *Beauv.*	. . . .	. . . . 4 . . . 8 .	. . . .
Danthonia provincialis, *DC.*	1 2 . . . . . 8 .	. . . . . . ? . . 9	. . 2 . . . . . 8 .
Triodia decumbens, *Beauv.*	1 2 3 4 . . 7 8 9	. . . . . . 6 . 8 9	0 1 . . 4 . . 7 8 9
Melica ciliata, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— uniflora, *Linn.*	. 2 3 4 . . 7 8 9	0 . . . 4 . 6 . . 9	0 . 2 . . . 6 7 8 .
—— nutans, *Linn.*	1 2 3 4 . . 7 8 9	. . . . . . 6 . 8 9	. . 2 3 4 . 6 7 8 9
Briza media, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— minor, *Linn.*	1	. . . . . . ? . . ?	. . 2 . ? . ? ? ? .
Eragrostis megastachya, *Link*	. . . . 8 9	. . . . . . 6 . . 9	. . 2 . 4 . 6 7 8 .
—— poæoides, *Beauv.*	. . . .	. . . . 4 . 6 . . 9	. . . . 7 8 .
—— pilosa, *Beauv.*	. . . 4 . . . 8 .	. . . . 4 5 6 . . .	0 1 2 3 4 . 6 7 8 .
Poa dura, *Scop.*	. . . . 8 .	. . . . . . ? . . 9	. . . . 7 . .
—— annua, *Linn.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (P. supina, *Schrad.*)	. . . . 8 .	. . . 3	. . . .
—— laxa, *Haenke*	1 . . . . 6 . 8 .	. 1 2 3 4 5 6 7 8 9	0 . . 3 4 5 . 7 8 .
—— ——, var. flavescens, *Koch*	. . . .	. . . 3	. . . . 8 .
—— ——, var. pauciflora, *Parl.*	. . . .	. . . .	. . . . . . 6 . . .

3 (0 1 2 3 4 5 6 7 8 9)	4 (0 1 2 3 4 5 6 7 8 9)	50	F A G I L C N P S K	
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P . K	Lasiagrostis Calamagrostis.
0 . 2 . 4 5 6 7 8 9	. 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	Phragmites communis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	Sesleria cærulea.
. . . .	. . . .	.	. . . . L C N . . .	—— argentea.
. . . . 9	. . . .	50	. . . I . C	—— ——, var. (S. elongata).
. . . . 7 8 9	. . . . . 5 . . . 9	.	. . G ?	—— microcephala.
. . 2 3 4 5 6 . 8 9	0 1 . 3 4 5 . 7 . 9	50	. . G I	—— sphærocephala.
. . . 3 . . 6 7 8 9	? . . 3 . 5 . 7 . .	.	. A G . . . . P . K	—— disticha.
. . . .	. . . .	.	F	—— ——, var. (S. pedemontana).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	Koeleria cristata.
. . . .	. . . 3 . . . 7 . .	50	. . . .	—— ——, var. ciliata.
. . . .	. . . .	.	F A G . . . . P . .	—— valesiaca.
. . . .	. . . .	.	. . . . L . . P . .	—— ——, var. (K. setacea).
. 1	0 . . 3	.	. A	—— phleoides.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	50	F A G I L C N P S K	Aira cæspitosa.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	.	F A G I L C N P S K	—— flexuosa.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	Holcus lanatus.
. . . 3 4	. . . 3 . 5 . . 8 .	.	F A G ? L C N P S K	—— mollis.
0 1 2 . 4 5 6 7 8 9	0 1 . 3 4 5 . 7 8 9	50	F A G I L C N P S K	Arrhenatherum elatius.
. . . 3 4 5 . . 8 9	0 . . 3 4 . . 7 . .	50	F A G I L C N P S K	Avena fatua.
. . . 3 4 5 . 7 8 9	. . . 3 . . . 7 . .	50	F A G I L . . P S K	—— pubescens.
. . . . 4 . . . 8 9	. 1 . 3	.	. . . .	—— ——, var. (A. lucida).
. . . 3 4 . . . 8 9	. . . . 7 . .	.	F . . . L C ? P . .	—— ——, var. (A. amethystina).
. . . . 4 5 . 7 8 9	. 1 2 3 4	.	F A G I L C N P S K	—— pratensis.
. . . 3 . . 6 7 8 9	. . . . 4 5 . 7 . .	.	F A G I ? C N P . K	—— Scheuchzeri.
. . . .	. . . .	.	F . . . L . . P . .	—— sempervirens.
. . . .	. . . .	.	F	—— setacea.
. . . .	. . . .	.	F . . . L . . P . .	—— montana.
. . 2 3 4 . . . 8 9	. 1 . 3 4 . . 7 . .	.	F ? G I	—— Hostii.
. . . .	0	.	F . . I . C N . . K	—— tenuis.
0 1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— flavescens.
. . 2 3 . . 6 7 8 .	. . . 3 4 5 . . . 9	.	. . G I . . . . . K	—— ——, var. (A. alpestris).
. . 2 3 . 5 6 . 8 9	. 1 . 3 4 . . 7 . 9	.	F A G I . . . . . K	—— distichophylla.
0 . 2 3 4 5 . . 8 9	0 . 2 3 4 5 . 7 . .	.	. A G I	—— argentea.
. . . . 7 8 9	. . . 3	.	F A G . . . . P S K	—— subspicata.
. . . .	. . . .	.	. A	—— Gaudiniana.
. . . . 4 . . . 8 .	. 1 . 3	50	F A G I L C N P S K	—— caryophyllea.
. . . . . 5 . . 8 .	. . . 3	.	. . . I L C N . . .	—— capillaris.
. . . . . 5 . . 8 .	. . . 3	.	. . . . L C N . . .	—— ——, var. (A. ambigua).
. . . .	. . . .	.	F A ? I . . . P S K	—— præcox.
. . . . 4	 9	.	F . . I L C . . . K	Danthonia provincialis.
0 . . . 4 5 . 7 8 9	. 1 . . 4 . . 7 . .	.	F A G ? L C N P S K	Triodia decumbens.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .	50	F A G I L C N P S K	Melica ciliata.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . . 8 .	.	F A G I L C N P S K	—— uniflora.
0 1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C ? P S K	—— nutans.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	Briza media.
. . . .	. . . .	.	. A . I L C N P . .	—— minor.
. . . . 4 5 . 7 8 .	0 . . . . . . 7 . .	50	F A . I L C N P . K	Eragrostis megastachya.
. . . . 4 5 . 7 8 .	0	.	F A G I L C N . . K	—— poæoides.
. . 2 3 4 5 . 7 8 .	0 1 . 3 4 . . 7 8 .	.	F A G I L C N ? . K	—— pilosa.
. . . . 4	. . . .	.	F A . I . C N . . K	Poa dura.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— annua.
. . . . . 5	. . . 3	.	. A G	—— ——, var. (P. supina).
. . 2 3 4 . 6 7 8 9	. . . 3 4 5 . 7 . 9	.	F A G ? . . . P S K	—— laxa.
. . . 3 . . 6 7 . .	. . . 3 . . . 7 . .	.	. . . .	—— ——, var. flavescens.
. . . . 7 . .	. . . .	.	. A G	—— ——, var. pauciflora.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Poa minor, *Gaud.*	. . . . 5 . . . 9	0 1	. . . . . 5 . 7 8 9
—— pumila, *Host*	. . . .	. . . .	. . . .
—— concinna, *Gaud.*	. . . . 8 .	. 1 2	. . . .
—— bulbosa, *Linn.*	1 2 3 4 . . 7 8 9	. 1 2 3 4 9	. . 2 . 4 5 6 7 8 9
—— alpina, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (P. badensis, *Haenke*)	. 2	. . . .	. . . . 8 .
—— cæsia, *Sm.*?	. . . .	. . . .	. . . . 8 .
—— nemoralis, *Linn.*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— fertilis, *Host*	. . . .	. . . .	. . . . 7 8 .
—— sudetica, *Haenke*	. 2 3 4 . 6 7 8 9	. 1 2 3 4 . 6 . . .	. . . . 4 5 . 7 8 .
—— hybrida, *Gaud.*	. . . .	. . . . . . 6 . . .	. . . .
—— trivialis, *Linn.*	1 2 3 4 . . 7 8 9	0 . 2 . 4 5 6 . 8 9	. . 2 . 4 5 6 7 8 9
—— pratensis, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (P. angustifolia, *Linn.*)	. . . . 8 9	. . . .	. . 2 . . . 6 7 . .
—— ——, var. anceps, *Koch*	. . . .	. 1	. . . . 7 8 .
—— cenisia, *All.*	1 . 3 . . 6 . 8 .	. 1 2 3 4 5 6 . . .	. . . . 4 . . . 8 .
—— compressa, *Linn.*	. 2 . 4 5 6 7 8 9	. 1 2 3 4 5 6 . 8 9	. . 2 3 4 5 6 7 8 9
Glyceria spectabilis, *Mert. & Koch.*	1 . 3 9	. . . . . . 6 . 8 9	0 . 2 . 4 . 6 . . .
—— fluitans, *R. Br.*	1 2 3 4 . . 7 8 9	0 1 2 3 4 5 6 . 8 9	0 1 . 3 4 5 . 7 8 9
—— ——, var. (G. plicata, *Fr.*)	1 2	. . . .	. . . . 7 8 .
—— distans, *Wahlenb.*	. . . .	. . . .	. . . . 4 . . 7 8 .
Catabrosa aquatica, *Beauv.*	. . . .	. . . .	 9
Molinia cærulea, *Moench*	1 2 3 4 5 . 7 8 9	0 1 2 . 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Diplachne serotina, *Link*	1 . . . . . . 8 .	. . . . . . 6 . . 9	. . 2 . 4 . 6 . 8 9
Dactylis glomerata, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Cynosurus cristatus, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 . 3 4 . 6 . 8 9	0 1 2 3 4 5 6 7 8 9
—— echinatus, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 . 8 9	0 . 2 . 4 . 6 7 8 9
Sclerochloa rigida. *Link*	1 2 3 4 . . 7 8 9	. . . . 4 . 6 . . 9	. 1 2 3 4 . 6 7 8 9
Vulpia Myurus, *Linn.*	1 2 . 4 . . . 8 9	0 . . . 4 5 . . . 9	0 1 2 3 4 . 6 7 8 .
—— ——, var. (V. sciuroides, *Roth*)	1	. . . .	0 . . . .
—— ciliata, *Link*	. . . .	. . . . 4	. . ? . . . . 7 8 .
—— geniculata, *Link*, var. *b. Parl.*	. . . .	. . . .	. . . .
Festuca hirsuta, *DC.*	. . . .	. . . . . 5 . . 8 .	. 1 . 3 4 5 6 . 8 .
—— Halleri, *All.*	1 2 3 4 . . . 8 9	0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 5 6 7 8 9
—— ovina, *Linn.*	1 . 3 . . . 7 8 9	0 . 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (F. Gaudini, *Kunth*)	. . . .	. . . .	. . . .
—— ——, var. (F. violacea, *Gaud.*)	. . 3 . . 6 7 8 9	. 1 2 . 4 . 6 7 8 .	. . . . . . 6 7 8 .
—— ——, var. (F. duriuscula, *Linn.*)	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— heterophylla, *Lam.*	1 2 3 . . . . 8 9	. 1 . . . . . 7 8 9	0 . 2 3 4 5 . 7 8 9
—— ——, var. (F. nigrescens, *Lam.*)	. . . .	. 1 2 . 4 5 6 . . .	. . . . 4 . 6 . 8 .
—— rubra, *Linn.*	. 2 . . . 6 . . .	. . 2 . . . ? . ? .	? . . 3 . . . 7 8 .
—— ——, var. (F. dumetorum, *Linn.*)	. . . .	. . . .	. . . .
—— varia, *Haenke*	1 2 3 4 . . 7 8 9	0 . . 3 4 5 6 7 8 .	. . . 3 4 . 6 7 8 9
—— ——, var. (F. xanthina, *Roem. & Schult.*).	. . . .	. 1	. . 2 . . . . . 8 .
—— ——, var. (F. Eskia, *Ram.*?)	. . . .	. . 2	. . . .
—— flavescens, *Bell.*	1 2 . . . 6 7 8 9	0	. . . .
—— pumila, *Vill.*	1 2 . . . 6 . 8 .	. 1 2 3 4 . ? . . .	. . . . . 5 . 7 8 .
—— pilosa, *Hall. fil.*	1 2 3 4 . 6 . 8 9	0 1 2 3 4 5 6 7 8 .	0 . . 3 4 5 . . 8 .
—— spectabilis, *Jan*	. . . .	. . . .	. . . . . . 6 . . .
—— spadicea, *Linn.*	1 2 3 4 5 . 7 8 9	0 . . . . . ? . . 9	. . 2 9
—— sylvatica, *Vill.*	. . 3 . . . . 8 9	. . . .	. . . .
—— Scheuchzeri, *Gaud.*	. . . .	. . . .	0 . . . . 8 .
—— gigantea, *Vill.*	1 2 3 4 . . 7 8 9	0 . . . 4 5 6 . . 9	. . . . 7 8 9
—— arundinacea, *Schreb.*	1 2 3 4	. 1 2 3 4 5 6 . 8 9	0 . 2 3 . . 6 7 8 9

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
. . . . 7 8 9	. . . .	.	F A G I . . . . . K	Poa minor.
. . . .	. . . .	50	. . . I	—— pumila.
. . . .	. . . .	.	. A . I	—— concinna.
0 1 2 3 4 5 . 7 8 9	0 1 2 3 . . . 7 8 .	50	F A G I L C N P S K	—— bulbosa.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— alpina.
. . . . 4 5 . 7 8 9	. . . 3 . . . 7 . .	.	. . G	—— ——, var. (P. badensis).
. . . . 8 9	. . . .	.	F A G I . . . . S ?	—— cæsia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— nemoralis.
. . . . . 5 . 7 8 .	. . . . 8 .	.	. A . I . . . . S K	—— fertilis.
. . . 3 9	. . . 3	.	F A G . . . N . . K	—— sudetica.
. . . . 9	. . . .	.	. A G . . . . . . K	—— hybrida.
0 1 . 3 4 5 . 7 8 9	0 1 . 3 4 . . 7 8 9	50	F A G I L C N P S K	—— trivialis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— pratensis.
. . . 3 . . . 7 8 .	. . . . 7 . .	50	F A G . L C N P ? ?	—— ——, var. (P. angustifolia).
. . . .	. . . .	.	. . . .	—— ——, var. anceps.
. . . . 7 . 9	. . . . 4	.	F A G I . . . P S ?	—— cenisia.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— compressa.
. . . . . 5 . 7 . .	0	.	F A G I L C N P S K	Glyceria spectabilis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	50	F A G I L C N P S K	—— fluitans.
. . . . . 5 6 . 8 9	. . . .	.	F A . . L C N P S K	—— ——, var. (G. plicata).
. . . . 4 5 . 7 8 .	. . . .	.	F . . I . . ? . S K	—— distans.
. . 2 . . 5 . 7 8 .	. . . . 7 . .	.	F A G I ? C N P S K	Catabrosa aquatica.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	.	F A G I L C ? P S K	Molinia cærulea.
0 1 2 . 4 5 6 7 8 .	0 1 2 3 . 5 6 . . .	.	F A . I L C N P . K	Diplachne serotina.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9	.	F A G I L C N P S K	Dactylis glomerata.
0 1 2 3 4 5 . 7 8 9	0 1 2 3 4 . 6 7 8 9	50	F A G I L C N P . K	Cynosurus cristatus.
. . 2 . 4	. . . .	.	F A G I L C N P . .	—— echinatus.
0 1 2 . 4 5 . . 8 .	0 1 . 3 . 5 . . . 9	50	F . . I L C N P . .	Sclerochloa rigida.
. 1 . . 4 5 . 7 8 .	0 1 . 3 . . . . 8 .	50	F A G I L C N P . K	Vulpia Myurus.
. . . .	. . . 3	.	F A G I L C N P S .	—— ——, var. (V. sciuroides).
. . 2 . 4 5	0	.	. . . I L C N P . .	—— ciliata.
. . . .	. . . 3	.	. . . . L C N P . .	—— geniculata.
. . . . . . 6 7 8 9	. . . 3 4	.	. A G . . . . . S .	Festuca hirsuta.
. . 2 3 4 5 6 7 8 9	0 . . 3 4 5 . . . 9	.	F A G I ? C N P . K	—— Halleri.
0 1 2 . 4 5 6 7 8 9	0 . . 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— ovina.
. . . . 8 .	. . . .	.	F A G I . . . P . .	—— ——, var. (F. Gaudini).
. . . . . . 6 . 8 9	. . . . 4	.	F A G . . . . P . K	—— ——, var. (F. violacea).
0 1 2 3 4 5 6 . 8 9	0 1 2 3 4 . 6 7 . 9	.	F A G I L C N P S K	—— ——, var. (F. duriuscula).
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	.	F A G I L C N P . K	—— heterophylla.
. . . . . 5 . . 8 9	. . . 3	.	F A G . . ? . . . K	—— ——, var. (F. nigrescens).
. . . . 7 8 9	. . . 3	.	F A G I ? . . P S K	—— rubra.
. . . . . 5 . . 8 9	. . . .	.	. A . . ? C . ? S K	—— ——, var. (F. dumetorum).
0 . 2 3 4 5 . . 8 9	. . . . 4 5 . 7 . .	.	F A G I . . . P . K	—— varia.
. . . 3 4	. . 2 3	.	. . G . . . . P . ?	—— ——, var. (F. xanthina).
. . . .	. . 2 3 . . . 7 . 9	.	. . . I . . . P . .	—— ——, var. (F. Eskia).
. . . .	. . . .	.	F . . . L	—— flavescens.
. . . . 4 . 6 7 8 9	. . . 3 4	.	F A G ? . . . . . K	—— pumila.
. . . . 4 5 . 7 8 9	. . . 3 4	.	. A G . . C N P . K	—— pilosa.
. 1 2 3 4 5 . . 8 9	. 1 . 3 4 . 6 . . .	.	. . . I	—— spectabilis.
0 1 . 3 4 9	0 . . 3 . . . 7 . 9	.	F A G I L C N P . K	—— spadicea.
. . 2 . 4 9	. . . .	.	F A G I ? C N P S K	—— sylvatica.
. 1 . . 4 . . 7 8 9	. 1 . 3 4 5 . 7 . .	.	. A G I . . . . . K	—— Scheuchzeri.
. . 2 3 4 5 . . 8 .	. . . . . 5 . 7 8 .	.	F A G I ? C ? P S K	—— gigantea.
0 1 2 . 4 5 6 . 8 9	0 . . 3 4 5	.	F A G I L C N P S K	—— arundinacea.

	0	1	2
	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Festuca pratensis, *Huds.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 . 9	0 1 2 3 4 5 6 7 8 9
—— loliacea, *Huds.*	. . . .	. . . .	. . . . 8 .
Brachypodium sylvaticum, *Beauv.*	1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 9
—— pinnatum, *Beauv.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 . 8 9	. . 2 . 4 . 6 7 8 9
—— distachyon, *Roem. & Schult.*	1 2 . . . . . 8 .	. . . .	. . . . 8 .
Bromus secalinus, *Linn.*	. . . . . . 7 . .	. . . . . . 6 . . 9	. . 2 . 4 5 6 7 8 .
—— ——, var. (B. velutinus, *Schrad.*).	. . . .	. . . .	. . . . 7 8 .
—— commutatus, *Schrad.*	. . . .	. . . .	. . . .
—— racemosus, *Linn.*	. 2	. . . .	. . . . . 5 . 7 8 .
—— mollis, *Linn.*	1 2 3 4 . 6 7 8 9	0 . . . . . 6 7 . 9	0 1 2 . 4 5 6 7 8 9
—— arvensis, *Linn.*	1 2 3 4 . . 7 . .	. 1 2 3 4 5 6 . 8 9	. . 2 . 4 5 6 7 8 .
—— patulus, *Mert. & Koch*	. . . . . 6 . . .	. . . .	. . . . 7 8 .
—— squarrosus, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 . . 9	. . 2 . 4 . 6 7 8 9
—— asper, *Linn.*	. . 3 . . . 7 8 9	. . . .	. . . . 4 5 . 7 8 .
—— erectus, *Huds.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— inermis, *Leyss.*	. 2	. . . .	. . . . 8 .
—— sterilis, *Linn.*	1 . 3 4 . . 7 8 9	. . . . 4 . 6 . . .	. . 2 . 4 5 6 7 8 9
—— tectorum, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 . 4 5 6 7 8 9
—— madritensis, *Linn.*	1 2	. . . .	. . . . 7 . .
—— ——, var. ciliatus, *Guss.*	. . . .	. . . .	. . . .
—— maximus, *Desf.*?	. . . . . . 7 . .	. . . .	. . . . 8 .
Nardurus Poa, *Boiss.*	. . . . . 6 . 8 .	 9	0 . . . ? . . . . .
—— unilateralis, *Boiss.*	. . . . 8 .	. . . .	. . . .
Triticum cristatum, *Schreb.*?	. . . .	. . . .	. . . .
—— repens, *Linn.*	1 2 3 4 . 6 7 8 9	. 1 2 3 4 5 6 . 8 9	0 1 2 3 4 5 6 7 8 .
—— ——, var. (T. glaucum, *Desf.*)	. . . .	. 1	. . . . 4 . . . . .
—— caninum, *Schreb.*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 .
—— ——, var. (T. biflorum, *Brign.*)	. . . .	. . . .	. . . .
Ægilops ventricosa, *Tausch*	. . . .	. . . . 4	. . . .
—— ovata, *Linn.*	1 2 . . . . . 8 .	. . . .	. . . . ? . .
Elymus europæus, *Linn.*	. 2 3	. . . . . . 6 . . .	. . . .
Hordeum murinum, *Linn.*	1 2 3 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— ——, var. (H. pseudo-murinum, *Tapp.*).	. . . .	. . . .	. . . .
Lolium perenne, *Linn.*	1 2 3 4 5 . 7 8 9	0 1 . . 4 . 6 7 8 9	0 1 2 3 4 5 6 7 8 9
—— italicum, *A. Br.*	. . . .	. . . .	. . . . 7 8 .
—— rigidum, *Gaud.*	. . . .	. . . . 4	. . . .
—— temulentum, *Linn.*	1 2 . . . . . 8 .	. . . . 4 . 6 . . 9	. . 2 . 4 . 6 7 8 .
—— multiflorum, *Gaud.*	. . . .	. . . .	. . . . 7 8 .
Psilurus nardoides, *Trin.*	. . . .	. . . .	. . . . 7 8 .
Nardus stricta, *Linn.*	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9

3	4			
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	
0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . . 8 .	50	F A G I L C ? P S K	Festuca pratensis.
. . 2 . . . . 7 8 .	. . . .	.	? ? ? ? . . . ? ? ?	—— loliacea.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5	50	F A G I L C N P S K	Brachypodium sylvaticum.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— pinnatum.
. . . .	0	.	. . . I L C N ? . .	—— distachyon.
. . . . 4 5 . . 8 9	0 . . . . . . 7 . .	.	F A G I L C . P S K	Bromus secalinus.
. . . . . 5	. . . .	.	. A . . . . N P . .	—— ——, var. (B. velutinus).
. . . 3 . 5 . . 8 .	. . . .	.	F A . . L C . P . .	—— commutatus.
. . . . . 5 . . . 9	. . . 3 . . . . 8 .	50	. A G I . C N . S K	—— racemosus.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 . 6 7 8 9	50	F A G I L C N P S K	—— mollis.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 8 .	.	F A G I L C N P S K	—— arvensis.
. . . 3 4 . . . 8 .	. . . 3 . . . 7 . .	.	F A . . L C . . S K	—— patulus.
. 1 2 3 4 5 6 7 8 .	0 . . 3 4 5	.	F A G I L C N . . K	—— squarrosus.
0 1 2 3 4 5 6 . 8 9	0 1 . 3 4 . . 7 . .	50	F A G I L C N P S K	—— asper.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	50	F A G I L C N P S K	—— erectus.
. . . .	. . . .	.	. A G ? . . . . S K	—— inermis.
0 1 . 3 4 5 6 7 8 9	0 1 2 3 4 . . 7 8 9	50	F A G I L C N P S K	—— sterilis.
. . 2 . . 5 6 . 8 9	. . . . 4 5 . 7 8 .	.	F A G I L C N P S K	—— tectorum.
. 1 2 . 4	. . . .	.	F . . I L C N P . .	—— madritensis.
. 1 2 . 4	. . . .	.	. . . . . . N . . .	—— ——, var. ciliatus.
. . . .	. . . .	.	. . . I L C N ? . .	—— maximus.
. . . .	. . . .	.	F A . I L C ? P . .	Nardurus Poa.
. . . .	0	.	. A . I L ? . ? . .	—— unilateralis.
. . . .	. . . 3	.	. . . . K	Triticum cristatum.
0 1 2 3 4 5 6 7 8 9	0 1 . 3 4 5 . 7 8 9	50	F A G I L C N P S K	—— repens.
. . . . 4 5 . 7 8 .	0 . . 3	.	F A G . L . . ? . K	—— ——, var. (T. glaucum).
0 1 2 3 4 5 . 7 8 9	0 1 . 3 4 5 . 7 . .	.	F A G I L C N P S K	—— caninum.
. . . .	. . . . 8 .	.	. . . .	—— ——, var. (T. biflorum).
. . . .	. . . .	.	. . . .	Ægilops ventricosa.
. . . . 4	. . . .	.	F . ? I L C N ? . .	—— ovata.
. . . .	. . . .	.	F A G ? . . N P S K	Elymus europæus.
0 1 2 3 4 5 6 7 8 .	0 1 2 3 4 . . 7 8 9	50	F A G I L C N P S K	Hordeum murinum.
. . . . 7 . .	. . . .	.	. . . .	—— ——, var. (H. pseudo-murinum).
0 1 2 3 4 5 . 7 8 9	0 1 . 3 4 . . 7 8 9	50	F A G I L C N P S K	Lolium perenne.
. . 2 . . 5	. . . .	.	. A G I . C N . . .	—— italicum.
. . . .	. . . .	.	F . . I . . N . . .	—— rigidum.
. . . 3 . 5 6 . 8 9	. . . 3 . 5 6 7 . .	.	F A G I L C N P S K	—— temulentum.
. . . .	. . . .	.	. A . . L C N P . .	—— multiflorum.
. . . . 4	0 1	.	F . . I L C N . . .	Psilurus nardoides.
0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 . 7 . 9	50	F A G I L C N P S K	Nardus stricta.

LINNEAN SOCIETY OF LONDON.

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[VOL. V. PART 5.

THE

TRANSACTIONS

OF

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ON SOME NORTH AMERICAN DESMIDIEÆ.

BY

WILLIAM WEST, F.L.S., AND G. S. WEST, ASSOC. ROY. COLL. SCIENCE.

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~~October~~ 1896.
December

V. *On some North American* Desmidieæ.

By W. West, *F.L.S., and* G. S. West, *Assoc. Roy. Coll. Science.*

(Plates XII.–XVIII.)

Read 20th June, 1895.

WHILE working up a number of gatherings of Desmids from the United States during the past few years, many new species and varieties have been observed, and our notes thereon have accumulated to such an extent that we considered it would be of interest to publish a few critical remarks, together with descriptions and figures of new forms.

Material was obtained from the late Rev. F. Wolle, Prof. Aubert of Maine State College, and others. The material supplied by the former was from various parts of the States, but we do not know the particular localities, and consequently cannot give them after the species. This material was exceedingly rich; out of one tube alone something like 320 species of Desmids were obtained, but in this case the richness was due to the fact that the contents of the tube consisted of the sediment from a number of other tubes from various parts of the United States. All Prof. Aubert's material was from Maine.

The descriptions given by Wolle in his 'Desmids of the United States' are in some cases very meagre, and the figures are often very inaccurate, so much so, that at times it is only with difficulty that one can be sure of the form he had under observation when he made his drawing. We have consequently given amended descriptions as well as accurate figures of some of his species that we have found which were not accurately described and figured by him.

We also wish to point out that in Wolle's 'Freshwater Algæ of the United States,' p. 42, pl. 62. figs. 7, 8, he records "*Staurastrum cosmarioides*, Reinsch." This is an error; it should be *Staurastrum Pseudocosmarium*, Reinsch (Contrib. Alg. et Fung. t. 9. fig. 1), and must not be confounded with *St. cosmarioides*, Nordst. (in Vidensk. Meddel. 1869 (1870) p. 223 t. 4. fig. 43).

Many species which are rare or very rare in Europe are quite abundant in the United States; these also are often the more remarkable species, especially those of the genus *Staurastrum*. Many species also attain larger dimensions there than in Europe; there are, however, cases where the reverse obtains: for instance, a few of the smaller species of *Staurastrum*. Other species are of a more or less unique character, none approaching them in form having as yet been observed from any other part of the world; such species are *St. Wolleanum*, Butler, *St. minnesotense*, Wolle, *St. xiphidiophorum*, Wolle, *St. genuflexum*, n. sp., *Cosmarium Eloiseanum*, Wolle, and *C. dentatum*, Wolle *.

* Since the above was written a paper has appeared by Prof. Schmidle in 'Hedwigia,' xxxiv. (1895), entitled "Einige Algen aus Sumatra," in which he describes and figures (p. 304, t. 4. f. 7) a new *Cosmarium*—*C. Askenasyi*; this species, which we have also recently observed in abundance from Singapore, is a close ally of *C. dentatum*, Wolle.

Genus GONATOZYGON, De Bary.

1. G. ACULEATUM, Hastings, in Amer. Month. Micr. Journ. (1892) p. 29.

Forma MINOR. (Pl. XII. figs. 1, 2). *G.* mediocre, diametro 8–12-plo longius, cylindricum, sed ad polos leviter dilatatum; membrana spinis longis rigidis numerosis obsessa.

Long. 125–160 μ; lat. ad med. 14–15 μ, ad pol. 15–17·5 μ; long. spin. 5·5–7·5 μ.

This was noticed by us some years ago, but only in single cells, and although an outlook has been kept for it ever since, no filaments have yet been found.

Mr. Hastings (*l. c.*) proposes to call a *Gonatozygon* which he found, *G. aculeatum*; this is most probably the same species that we have observed. The *G. pilosum* figured by W. B. Turner (Freshw. Alg. of E. India, pl. 20. figs. 1, 2) may be a more slender variety of this species; it is certainly not like the *G. pilosum*, Wolle, we have seen.

Genus PHYMATODOCIS, Nordst.

2. P. NORDSTEDTIANA, Wolle, Desm. U.S. p. 28, pl. 49. figs. 1-4.

Forma MINOR, Bœrg. in Vidensk. Meddel. 1890 (1891), p. 25 et fig. xylogr.

Long. 33–38·5 μ; lat. 27–34·5 μ; lat. isthm. 11·5–15 μ. (Pl. XII. figs. 3–6.)

In all the specimens observed the apices of the cells were a little narrower than across the middle; this is also shown in the figures given by Nordstedt of var. *novizelandica* (Freshw. Alg. of New Zeal. & Austr. pl. 2. figs. 1, 2). The lateral margins are also less undulate than either the example figured by Wolle or that given by Bœrgesen; the sinuses also, although somewhat open, are not ampliated like either of the above-mentioned figures. Nordstedt, in Öfvers. Sv. Vet.-Akad. Förh. (1877) n. 3, p. 19, in his definition of the genus, states that the filaments are not twisted; Wolle says they are "not at all or only slightly twisted"; our specimens are distinctly twisted (as much as a *Desmidium*).

Genus SPHÆROZOSMA, Corda.

3. S. AUBERTIANUM, West, in Journ. Bot. xxvii. (1889) p. 206, t. 291. fig. 17; in Journ. Linn. Soc. (Bot.) xxix. (1892) p. 115, pl. 19. fig. 1. Zygosporæ globosæ vel subglobosæ, aculeis longis curvatis basi latioribus cum papillâ obtusâ intra basin uniuscujusque spinæ.

Diam. zygosp. sine spin. 19–24 μ, cum spin. 37·5–42 μ. (Pl. XII. figs. 7, 8.)

Hab. Orono, Maine.

S. Archerii, Gutw., in Sprawozd. Akad. Krak. xxvii. II. (1892) p. 29, t. 1. fig. 4, differs from *S. Aubertianum* only in having two transverse series of granules across the semicells in addition to the two at the margin. Further specimens examined show that *S. Aubertianum* has often a few additional granules within the margin of the semicells; moreover, the zygospores we have recently found correspond exactly to those of *S. Archerii*, Gutw. As the latter species was described some years later and differs so little from *S. Aubertianum*, we place it under this species as var. *Archerii* nobis.

S. filiforme, W. B. Turn. Freshw. Alg. of E. India, p. 142, t. 18. fig. 20, seems to us very near this variety, but has a more open sinus.

4. SPHÆROZOSMA EXCAVATUM, Ralfs, Brit. Desm. p. 67, t. 6. fig. 2.

Var. (Pl. XII. fig. 9.)

Long. 8·5–10 μ; lat. cum apic. 9·5–10·5 μ; lat. isthm. 4·8–5·5 μ.

Only one filament of this variety was seen; it has a tubercle on each lateral margin of each semicell similar to those on *S. indicum*, W. B. Turn. [Freshw. Alg. of E. India, p. 141, t. 18. fig. 2 (= *S. excavatum*, var. γ, G. C. Wall. in Ann. & Mag. Nat. Hist. ser. III. v. (1860) p. 192, t. 7. fig. 16)].

Genus SPONDYLOSIUM, Bréb.

5. S. PULCHRUM, Arch. in Pritch. Infus. ed. IV. p. 724. (*Sphærozosma pulchrum*, Bail. in Ralfs, Brit. Desm. p. 209, t. 35. fig. 2.)

Var. INFLATUM, nobis. (*Sphærozosma pulchrum*, Bail., var. *inflatum*, Wolle, Desm. U.S. p. 29, pl. 49. fig. 8.) Forma apicibus cellularum minus productis; a vertice visis constrictionibus duabus, parte centrali pæne circulari, partibus lateralibus majoribus et ovalibus.

Long. cell. 34–40 μ; lat. 58–73 μ; lat. isthm. 14–19·5 μ; lat. apic. 10–13·5 μ; crass. (part. centr.) 16 μ. (Pl. XII. fig. 10.)

Var. CONSTRICTUM, nobis. (*Sphærozosma pulchrum*, Bail., var. *constrictum*, Wolle, Alg. U.S. p. 22, pl. 59. fig. 12.) (Pl. XII. figs. 11, 12.)

Long. 50–58 μ; lat. 86–96 μ; lat. isthm. 23–26 μ; lat. apic. 19–21 μ.

All the specimens of this variety observed were not so stiffly and geometrically constricted as Wolle figures them, and the sinus was more open on account of the constrictions being nearer the lateral angles of the semicells.

6. S. RECTANGULARE, nobis. (*Sphærozosma rectangulare*, Wolle, Desm. U.S. p. 31, pl. 19. fig. 9; *Sphærozosma Gœbelii*, Racib. in Flora (1895), I. p. 32, tt. 3, 4. fig. 5. (Pl. XII. figs. 13, 14.) *S.* magnum, filis non tortis, sine vaginâ mucosâ; cellulæ compressæ, 3-plo latiores quam longiores, profundissime constrictæ, sinu angustissimo-lineari ad extremum subampliato; semicellulis transverse et anguste oblongo-rectangulares, dentibus duobus divergentibus ad angulos marginis lateralibus uniuscujusque et dente singulo intra marginem ad medium, apicibus rectis (retusis in medio [Wolle]); a latere visæ semicellulæ depresso-globosæ, cum dente divergente ad marginem lateralem unumquemque; pyrenoidibus binis in semicellulâ unâquâque.

Long. 19–23 μ; lat. sine dent. 56–61 μ; lat. cum dent. 61–66 μ; lat. isthm. 10·5–12·5 μ; crass. cum dent. 17–19 μ.

The plant described and figured by Wolle as *Sphærozosma rectangulare* certainly belongs to the genus *Spondylosium*: there is no doubt that the plant we have found is the same species as that which Wolle had under observation, but the compressed cells have truncate *closely applied* apices and dentigerous lateral margins. The filaments are not twisted like those of *Spondylosium pulchrum*. So far as could be observed in the preserved specimens examined, the chlorophyllaceous mass in each semicell contained two pyrenoids, oval or elliptic in form, which were directed obliquely downward towards

each other. Wolle's imperfect figure and description have evidently led Raciborski (*l. c.*) to describe the plant as a new species.

Genus Onychonema, G. C. Wallich.

7. O. læve, Nordst. in Vidensk. Meddel. 1869 (1870), p. 206, t. 3. fig. 34.

Var. micracanthum, Nordst. Alg. et Char. i. p. 3. (Pl. XII. figs. 15–17.) Zygosporæ globosæ, spinis validis simplicibus numerosis brevibus obsessæ.

Diam. zygosp. sine spin. 17–20 μ, cum spin. 24–26 μ.

The var. *micracanthum* appears to be much more abundant than the typical plant. An abnormal form was seen with an oblong-elliptic portion between the two semicells of each cell; this was slightly larger than the semicells, but of about the same breadth. It was present in all the cells of a long filament, and appears to have resulted from the abnormal development during division of what should have produced two young semicells. We have also seen this abnormal form in *O. filiforme*. Similar cases occur not unfrequently in *Staurastrum* and *Cosmarium*, especially in the latter.

Var. latum, nov. var. (Pl. XII. fig. 18.) Var. cellulis compressis, latioribus et subangularibus, apicibus pro parte tertiâ apicis uniuscujusque levissime elevatis et truncatis; a vertice visis angustioribus, lateribus subrectis; membrana punctata.

Long. 15–15·5 μ; lat. sine spin. 28·5–30·5 μ, cum spin. 36·5 μ; lat. isthm. 3·8–4·6 μ; crass. 7 μ.

Genus Hyalotheca, Kuetz.

8. H. undulata, Nordst. in Wittr. & Nordst. Alg. Exsic. no. 248.

Long. cell. 10–15 μ; lat. 6–7 μ; lat. isthm. 4·6–5 μ.

This characteristic species was met with frequently. It cannot possibly be confounded with *Sphærozosma excavatum* as stated by Wolle (Desm. U.S. p. 24). The diameter of our examples is the same as that of the original Swedish plant and also of British specimens; Wolle says 9–12 μ (his figure is 14 μ!).

Genus Gymnozyga, Ehrenb.

9. G. moniliformis, Ehrenb. (*Bambusina Brebissonii*, Kuetz.; *Didymoprium Borreri*, Ralfs.)

Var. gracilescens, Nordst. in Wittr. & Nordst. Alg. Exsic. no. 367.

Long. zygosp. 21–23 μ; lat. zygosp. 16–17 μ. (Pl. XII. fig. 19.)

This has been found with zygospores by Nordstedt (in Wittr. & Nordst. Alg. Exsic. no. 554) from Brazil and by Wolle (Alg. U.S. p. 21, pl. 59. figs. 13, 14) from Florida. We give a figure of a few of the zygospores observed by us.

10. G. confervacea, nov. sp. (Pl. XII. figs. 20, 21.) *G.* cellulis subrectangularibus, 1⅓–2-plo longioribus quam latioribus, leviter latioribus ad medium, annulo singulo delicatissimo mediano; membrana glabra.

Long. 12–18·5 μ; lat. 9–10·5 μ; lat. med. 10·5–12 μ.

This has shorter and stouter cells than *G. delicatissima*, Lagerh., and has only a single median delicate band.

11. Gymnozyga delicatissima, Nordst. in Wittr. et Nordst. Alg. Exsic. in observ. ad no. 803; Lagerh. in Notarisia, anno iii. (1888) fasc. 12, p. 595. (*Bambusina delicatissima*, Wolle, Desm. U.S. p. 25, pl. 1. figs. 22–24.)

Long. 15·5–18 μ; lat. 6·5–7 μ. (Pl. XII. fig. 22.)

The examples noticed by us had shorter cells than Wolle's, the length hardly ever being three times the breadth. The two median bands were quite delicate in their character.

Genus Desmidium, Agardh.

12. D. Aptogonum, Bréb. Alg. Falaise, p. 65, t. 2. (*Aptogonum Desmidium*, α, Ralfs, Brit. Desm. p. 64, t. 32. fig. 1.) Zygosporæ subglobosæ vel late ellipticæ, glabræ.

Long. zygosp. 22–27 μ; lat. zygosp. 20–25 μ. (Pl. XII. fig. 24.)

The cells of the conjugated filaments were all somewhat disjointed.

Var. Ehrenbergii, Rabenh. Fl. Europ. Alp. iii. p. 154. (*Odontella Desmidium*, Ehrenb.; *Aptogonum diagonum*, Delp. Spec. Desmid. Subalp. p. 76, t. 3. figs. 6–10.) (Pl. XII. fig. 23.) Forma cellulis latioribus brevioribusque; a vertice visis oblongis cum lateribus rectis et apicibus inflatis.

Long. cell. 14·5–15·2 μ; lat. 34–35 μ; lat. isthm. 25–26·5 μ; crass. 7·5 μ.

When seen in front view this so much resembles *Desmidium Aptogonum*, that it must be but a variety of it. *Aptogonum diagonum*, Delp., appears to be only a form of this variety, though it differs from what we have seen in its longer and thicker cells.

13. D. cylindricum, Grev. Scot. Crypt. Fl. p. 292 et tab. (*Didymoprium Grevillei*, Kuetz. Phycol. General. p. 166; Ralfs, Brit. Desm. p. 57, t. 2.)

A figure is given of a zygospore of this species (long. 43 μ, lat. 36 μ). (Pl. XII. fig. 29.)

Var. obliquum, nov. var. (Pl. XII. fig. 30.) Var. semicellulis a vertice visis latere uno convexis, latere altero valdissime convexis (semicircularibus).

Lat. 61 μ; crass. 49 μ.

14. D. coarctatum, Nordst. Freshw. Alg. of New Zeal. & Austr. p. 25, pl. 2. fig. 3.

Long. 22–32 μ; lat. 37–41 μ; lat. apic. 15–17 μ; lat. isthm. 28–30 μ.

15. D. quadratum, Nordst. Bidrag Sydlig. Norges Desm. p. 49, fig. 24.

Long. cell. 14–17 μ; lat. 21–23 μ; lat. isthm. 18–19 μ; crass. 17·5–18 μ.

A few exactly typical filaments of this were observed, and as Wolle's figure (Desm. U.S. pl. 49. fig. 5) is not a representative one—the lateral incisions of the cells especially being too deep—we give one (Pl. XII. fig. 25).

15*. D. æquale, nov. sp. *D.* a *D. quadrato* differt cellulis majoribus, a fronte et a latere visis latioribus, zygosporis globosis, undulato-nodulosis. (Pl. XII. fig. 28.)

a. elliptica (Pl. XII. fig. 17) cellulis a vertice visis subcircularibus et subporrectis ad polos.

b. trigona (Pl. XII. fig. 26) cellulis a vertice visis trigonis, lateribus convexis et angulis subporrectis.

Long. 17–19 μ; lat. 29–31 μ; lat. apic. 21–22 μ; lat. isthm. 28 μ; diam. zygosp. 25 μ.

This species was in great abundance, and seems very characteristic, as the filaments are of a more uniform breadth throughout than are those of any other species belonging to the subgenus *Didymoprium*.

Genus Docidium, Bréb.

16. D. Baculum, Bréb. in Ralfs, Brit. Desm. p. 158, tab. 33. fig. 5.

Long. 296–348 μ; lat. ad bas. semicell. 12·5–13 μ; lat. ad medium semicell. 9·6 μ.

The description and figure given by Wolle (Desm. U.S. p. 49, pl. 11. figs. 3, 4) do not belong to this species. This cosmopolitan species is always constant in its characters, always having a basal inflation with a slight constriction immediately above it and the plications at the base. The *Docidium Baculum* recorded by Prof. F. L. Harvey from Maine (in Bull. Torr. Bot. Club, vol. xix. Apr. 1892, p. 122) is not that species, as he refers it to Wolle's figure, and his measurements (long. 425 μ, lat. 25 μ !) are much too large. We give a figure (Pl. XII. fig. 35) of the largest specimen we have ever seen (and that an American one); the breadth of this species is fairly constant.

Genus Pleurotænium, Näg.

17. P. nodosum, Lund. Desm. Suec. p. 90. (*Docidium nodosum*, Bail. in Ralfs, Brit. Desm. p. 218, t. 35. fig. 8.)

North American examples of this species attain very much larger dimensions than do British forms. A figure is given (Pl. XII. fig. 31) of an abnormal semicell (long. semicell. 329 μ; lat. ad bas. infl. 67 μ; lat. apic. 41 μ) possessing an extra nodose projection on one side, causing the semicell to be bent at that point.

18. P. constrictum, Lagerh. in Öfvers. Sv. Vet.-Akad. Förh. (1855) n. 7, p. 251. (*Docidium constrictum*, Bail. in Ralfs, Brit. Desm. p. 218, t. 35. fig. 7.)

Long. 415–500 μ; lat. ad bas. semicell. 41–48 μ; lat. apic. 26–30 μ.

The constrictions of the semicells of this species vary considerably in depth in different examples. Sometimes the two semicells of the same plant are differently constricted; in one specimen the breadth across the constrictions of one semicell was 40—36—34 μ, and that across those of the other only 33—31—26 μ. The number of constrictions present on a semicell may be either 3 or 4. The apical papillæ are also subject to considerable variation; in some cases they are mere rounded granules, whereas in others they are long and very sharp teeth.

19. P. hypocymatium, nov. sp. (Pl. XIII. fig. 1.) (? *Docidium Baculum*, Bréb. var. *floridense*, Wolle, Alg. U.S. p. 26, pl. 54. fig. 5.) *P.* parvum, circiter 28-plo longius quam latius, vix attenuatum, lateribus leviter undulatis, undulis apices versus gradatim minoribus, lateribus infra apices rectis; apicibus subtruncatis granulis 4 (visis) juxta marginem ornatis; membranâ minute et irregulariter punctatâ.

Long. 396 μ; lat. ad bas. semicell. 16 μ; lat. apic. versus 12·5 μ.

We have seen this species not unfrequently; it may be compared with *P. annulatum* and *P. basiundatum*, West.

20. Pleurotænium subcoronulatum, West & G. S. West, in Trans. Linn. Soc. ser. II. (Bot.) v. (1895) p. 44, pl. 5. fig. 33. (*Docidium subcoronulatum*, W. B. Turn. Freshw. Alg. of E. India, p. 29, t. 3. fig. 1.)

Var. detum, nov. var. (Pl. XIII. figs. 2, 3.) Var. semicellulis subito constrictis infra apices dilatatis, constrictione ad partem septimam longitudinis (circiter) a polo sitâ; tuberculis 26–30 (visis—14–16).

Long. 404–446 μ; lat. ad bas. semicell. 29–38·5 μ; lat. ad constrict. infra apic. 20–27 μ; lat. ad apic. 27–28 μ.

21. P. parallelum, West & G. S. West, in Trans. Linn. Soc. ser. II. (Bot.) v. (1895) p. 45, pl. 5. fig. 34.

Long. 727–891 μ; lat. ad bas. semicell. 50–52 μ; lat. ad apic. 36–39 μ.

22. P. Sceptrum, nobis. (*Docidium Sceptrum*, Kuetz. Species Algarum, p. 168; Roy, in Scottish Nat. (1883–4) p. 37; *Docidium tridentulum*, Wolle, Desm. U.S. p. 52, pl. 10. fig. 10; *Pleurotænium tridentulum*, West, in Journ. Linn. Soc. (Bot.) xxix. (1892) p. 120.)

A figure of a typical specimen is given.

Long. (sine dent.) 250 μ; lat. ad bas. semicell. 12·5 μ; lat. apic. 7·5 μ. (Pl. XIII. fig. 6.)

Var. capitatum, West. (*Pleurotænium tridentulum* var. *capitatum*, West, *l. c.* pl. 24. fig. 12.) (Pl. XIII. figs. 7, 8.)

Long. 330–360 μ; lat. ad bas. semicell. 12–13·5 μ; lat. ad apic. 7·5–8·5 μ.

23. P. trochiscum, nov. sp. (Pl. XIII. figs. 4, 5.) *P.* mediocre, circiter diametro 15–16-plo longius; semicellulæ cylindricæ lateribus rectis; vix attenuatum polis, cum inflatione parvâ ad basin, apicibus truncatis; membrana annulis 13–15 impressionum irregularium subquadrangularium vel oblongarum (non in series longitudinaliter ordinatis), circiter 6 annulo unoquoque (impressiones *partes tenuissimæ* membranæ sunt—verrucæ non sunt), impressionibus intra inflationem basalem minoribus irregularibus et numerosioribus, iis intra polos irregulariter elongatis (interdum fractis) in parte octavâ semicellulæ uniuscujusque.

Long. 416–458 μ; lat. ad bas. semicell. 29–38 μ; lat. med. semicell. 25–31 μ; lat. apic. 21–27 μ.

The somewhat quadrangular markings on this species are due to those portions of the membrane which are not internally thickened, and, being the thinnest parts of the membrane, are analogous to the pits in the large vessels of the xylem of angiosperms. It differs from *Pleurotænium tessellatum*, Lagerh. (i. e. *Docidium tessellatum*, Josh., in Journ. Linn. Soc. (Bot.) xxi. (1886) p. 650, t. 25. fig. 15), in having a distinct basal inflation, in not being attenuated to the apex, which is, moreover, without teeth. The rings of markings are also more numerous: the markings are fewer in each ring, they are not regularly oblong and are not in longitudinal series. Lagerheim (in Öfvers. Sv. Vet.-Akad. Förh. (1887) n. 8, p. 541) states that the elongated warts at the apex of *P. tessellatum* are only faintly indicated; in our plant they are most clearly indicated and only occupy about an eighth part of the semicell. It differs from *P. verrucosum*

[Wolle, Desm. U.S. p. 52, pl. 10. figs. 4, 5] in having a basal inflation, in having straight sides (not crenulate), in having much fewer markings in each ring, and in the rings not extending regularly to the apex. It is very different from *P. egregium*, nobis [=*Docidium egregium*, W. B. Turn. Freshw. Alg. of E. India, p. 34, pl. 2. figs. 14, 15], the only other *Pleurotænium* of this class.

Genus TRIPLOCERAS, Bail.

24. T. GRACILE, Bail. Micr. Obs. p. 38, t. 1. fig. 10; Nordst. Freshw. Alg. of New Zeal. & Austr. pp. 64, 65; W. B. Turn. Freshw. Alg. of E. India, pp. 25, 26, t. 2. figs. 1–4; *Docidium gracile*, Wittr. Anteck. Skand. Desm. p. 21, t. 1. fig. 10. (Pl. XIII. figs. 9–13.) Forma semicellulis apice truncatis (vel leviter convexis), ad angulum unumquemque spinâ brevi validâ extrorsum curvatâ, lobulis duobus (vel processibus) profunde bifidis (interdum trifidis) instructis.

Long. 312–422 μ; lat. ad bas. semicell. (c. spin.) 24·5–26·5 μ; lat. apic. 21–25 μ.

Hab. Minnesota.

All the specimens examined had apices of this character, which are not like the apices of any published forms.

Genus CLOSTERIUM, Nitzsch.

25. C. ABRUPTUM, West, in Journ. Roy. Micr. Soc. 1892, p. 719, pl. 9. fig. 1. Zygosporæ globosæ, glabræ. (Pl. XIII. figs. 14, 15.)

Long. 127–135 μ; lat. 12·5–14·5 μ; lat. apic. 6 μ; diam. zygosp. 32–46 μ.

Hab. Orono, Maine.

26. C. BRAUNII, Reinsch, Algenfl. Franken (1867), p. 196, t. 12. fig. 5; Joshua, in Journ. Bot. xxiii. (1885) p. 35, t. 254. fig. 9; *Closterium areolatum*, H. C. Wood, 1874; Wolle, Desm. U.S. p. 43, pl. 7. figs. 3, 4; *C. maculatum*, Hastings, in Amer. Monthl. Micr. Journ. xiii. (1892) p. 154, pl. 1. fig. 5. (Pl. XIII. figs. 16, 17.)

Long. 622 μ; lat. 43 μ; lat. apic. 10–11 μ.

Hab. Scarbro', Maine.

This has also been observed by Joshua from Nova Scotia, and the figure he gives is more accurate than that of Reinsch. The plant we observed had altogether 10 striæ, each composed of an irregular double series of granules, most of which were longitudinally elongated. Between the striæ the membrane is irregularly punctulate; the poles are similar to those of *C. turgidum*, but not so much recurved.

C. areolatum, H. C. Wood, seems to be identical with Reinsch's species. Thus the forma *simplicior*, Gutw., and forma *glabra*, Gutw., in Sprawozd. Akad. Krak. xxx. II. (1895) pp. 36, 37, t. 2. figs. 10, 11), of *C. areolatum*, Wood, must be regarded as forms of *C. Braunii*, Reinsch.

27. C. PRÆLONGUM, Bréb.; Rabenh. Fl. Europ. Alg. iii. p. 130.

Forma BREVIOR, Nordst., Freshw. Alg. of New Zeal. & Austr. p. 68, pl. 3. figs. 22–24.

Long. 230–320 μ; lat. 13·5–16 μ.

28. Closterium Cynthia, De Not. Desm. Ital. p. 65, t. 7. fig. 71; Cooke, Brit. Desm. pp. 26–27.

Long. 73–76 μ; lat. 11–14 μ. (Pl. XIII. figs. 18, 19.)

Hab. Bog between Orono and Bangor, Maine.

29. C. dilatatum, nov. sp. (Pl. XIII. figs. 20–22.) *C.* mediocre, cellulis diametro 8-plo longioribus, modice curvatis, gradatim attenuatis ad polos, polis leviter dilatatis, apicibus angulari-convexis, angulis lateralibus polorum subincrassatis; membranâ achroâ delicatissimâ sed sparsim striolatâ, striis visis 6.

Long. 218–228 μ; lat. 28–29 μ; lat. apic. 9·5 μ.

This species is less curved than *C. lagoense*, Nordst. (in Vidensk. Meddel. 1869 (1870) p. 203, t. 2. fig. 2), has fewer striæ, and is less attenuated towards the poles, the dilated portion of which is also shorter.

30. C. costatum, Corda, Almanach de Carlsbad, 1835, p. 124, t. 5. figs. 61–63; Ralfs, Brit. Desm. p. 170, t. 29. fig. 1. Forma cellulis minus curvatis et apicibus truncatis; striis 4 in 15·5–17 μ; membrana inter strias punctata.

Long. 230–301 μ; lat. 26–29 μ; lat. apic. 6–9 μ. (Pl. XIII. figs. 23, 24.)

Genus Penium, Bréb.

31. P. annulare, West, in Journ. Bot. xxix. (1891) p. 354, t. 315. figs. 5, 6.

Long. 190 μ; lat. 23 μ; lat. apic. 19 μ.

Hab. Harvey Lake, Lycoming Co., Pa.

Mr. N. L. Johnson of Ann Arbor informs us that he has this species in abundance from Louisiana at a point over a thousand miles from the locality (Scarbro') in Maine where it was first gathered.

32. P. inconspicuum, West, in Journ. Roy. Micr. Soc. (1894) p. 4, pl. 1. figs. 6, 7.

Long. 19 μ; lat. 5·8 μ. (Pl. XII. fig. 34.)

Hab. Harvey Lake, Lycoming Co., Pa.

33. P. minutum, Cleve. (*Docidium minutum*, Ralfs.)

Var. gracile, Wille, in Christ. Forh. Vidensk.-Selsk. 1880 (1881), n. 11, p. 51, t. 2. fig. 33; West, in Journ. Linn. Soc. (Bot.) xxix. (1892) p. 129. (Pl. XII. figs. 32, 33.)

Long. 142–268 μ; lat. 7·5–8·5 μ.

Some of the forms noticed were much longer than Wille's, some being 30 times as long as broad.

Genus Cylindrocystis, Menegh.; De Bary.

34. C. angulata, nov. sp. (Pl. XIII. figs. 25, 26.) (*C. tumida*, Wolle, Alg. U.S. p. 23, pl. 56. figs. 7, 8, non F. Gay.) *C.* submagna, circiter 2½-plo longior quam latior, emarginatim constricta ad medium; semicellulæ truncato-conicæ, lateribus rectis, apicibus subrectis angulis levissime rotundatis; membranâ scrobiculato-punctatâ; pyrenoidibus singulis magnis.

Long. 65–69·5 μ; lat. 29–31 μ; lat. apic. 11·5 μ; lat. constrict. 27·5–28·5 μ.

The plant which came under our observation was evidently the same species as that figured by Wolle, though he says "membrane smooth"; all those noticed by us were minutely scrobiculate. *C. tumida*, F. Gay (in Rev. Sc. Nat. sér. III. iii. (1883) p. 228, t. 1. fig. 1), is a very different plant, with no constriction, no angularity, and a smooth membrane.

Genus TETMEMORUS, Ralfs.

35. T. GRANULATUS, Ralfs, Brit. Desm. p. 146, t. 24. fig. 3.

Var. ATTENUATUS, West, in Journ. Linn Soc. (Bot.) xxix. (1892) p. 132, pl. 20. fig. 7.

Long. 303 μ; lat. ad bas. semicell. 42 μ; lat. isthm. 37 μ; lat. ad apic. 21–22 μ; lat. subapic. 21–23 μ.

This is a larger form than the Irish plant, but otherwise precisely the same. The figure published of the above was not a good one and did not show the attenuation sufficiently.

Genus MICRASTERIAS, Agardh.

36. M. ARCUATA, Bail. in Smithson. Contrib. to Knowl. 1850, p. 37, t. 1. fig. 6; Wolle, Desm. U.S. p. 117, pl. 38. fig. 5; Nordst. in Öfvers. Sv. Vet.-Akad. Förh. (1877) n. 3, p. 22, cum fig. xylogr. ii. 1–2.

Var. GRACILIS, nov. var. (Pl. XIII. fig. 27.) Var. gracilior, lobis multo angustioribus, lobo polari processibus subconvergentibus; apicibus omnibus loborum mucronatis (vide Nordst.).

Long. 77–81 μ; lat. 98–115 μ; lat. isthm. 9–10·5 μ.

Hab. Harvey Lake, Lycoming Co., Pa.

37. M. PINNATIFIDA, Ralfs, Brit. Desm. p. 77, t. 10. fig. 3. (*Euastrum pinnatifidum*, Kuetz. Phycolog. Germ. p. 134.) Zygospora globosa, spinis longis validis attenuatis acutis ornatis, cum papillâ obtusâ intra basin uniuscujusque spinæ.

Diam. zygosp. sine spin. 44 μ, cum spin. 67 μ. (Pl. XIII. fig. 28.)

Forma major, lobis longioribus et tenuioribus.

Long.	78 μ;	lat.	96 μ;	lat. isthm.	12 μ.
,,	82·5 μ;	,,	100 μ;	,, ,,	12·5 μ.
,,	82·5 μ;	,,	105 μ;	,, ,,	12·5 μ.
,,	81 μ;	,,	106 μ;	,, ,,	13 μ.

Forma. (Pl. XIII. fig. 29.)

Long. 54 μ; lat. 55–62 μ; lat. isthm. 12 μ.

Hab. Harvey Lake, Lycoming Co., Pa.

This form had one semicell like var. *inflata*, Wolle (Desm. U.S. p. 116, pl. 37. fig. 9=var. *quadrata*, W. B. Turn. Freshw. Alg. of E. India, p. 89, t. 5. fig. 3 *b*), the other semicell being like var. *expansa*, W. B. Turn. (*l. c.* fig. 3 *c*), thus showing these are but forms of the same variety.

38. M. DEPAUPERATA, Nordst. in Vidensk. Meddel. 1869 (1870), p. 222, cum fig.). Forma major, spinis curvatis ad angulos furcatos, lobo polari breviori; membranâ delicatissime punctatâ.

Long. 155 μ; lat. (cum spin.) 142 μ; lat. isthm. 27 μ. (Pl. XIV. fig. 1.)

Hab. Harvey Lake, Lycoming Co., Pa.

We agree with Lagerheim (in Öfvers. Sv. Vet.-Akad. Förh. (1889) n. 8, p. 536) that *Micrasterias Kitchelii*, Wolle (Desm. U.S. p. 116, pl. 37. figs. 1, 2), belongs to this species; it is larger and has distinctly produced angles, a shorter polar lobe, and a more open sinus; it should be called var. *Kitchelii*, nobis.

39. Micrasterias furcata, Ralfs, Brit. Desm. p. 73, t. 9. fig. 2.

North American forms of this species are very variable with regard to the division of the lateral lobes. Mr. N. L. Johnson, in Bot. Gaz. vol. xix. (1894) pp. 58–60, pl. 6. figs. 7–14, writes upon this variability, and after examining a large number of specimens showing these variations we agree with him that *M. pseudofurcata*, Wolle (Desm. U.S. p. 111, pl. 35. fig. 4; *M. furcata* var. *decurta*, W. B. Turn. in Journ. Roy. Micr. Soc. (1885) p. 934, pl. 16. fig. 10), and *M. furcata* var. *simplex*, Wolle (Alg. U.S. p. 40, pl. 59. figs. 6, 7), are but forms of the species. This variability applies only to North American forms so far as our own observations go.

A peculiar densely punctate form (long. 127 μ, lat. 115–120 μ, lat. isthm. 26 μ) was seen in which the superior lateral lobe on one side was divided at right angles to the plane of the plant, while the corresponding lobe on the other side was divided in the usual way; but the superior lobelet was again divided at right angles to the plant, these latter divisions not being forked. (Pl. XIV. fig. 3.)

Another peculiar form (long. 217 μ, lat. 211 μ, lat. isthm. 20 μ) is figured (Pl. XIV. fig. 2) which approaches *M. dichotoma*, Wolle; it is in fact an intermediate form between the latter and *M. furcata*. The *M. dichotoma*, Wolle, figured by Lagerheim (in Öfvers. Sv. Vet.-Akad. Förh. (1885) n. 7, p. 231, t. 27. fig. 4) appears to connect this form with that figured by Wolle. Is not *M. dichotoma* an extreme form of *M. furcata*?

M. furcata forms:—

Long. 125–151 μ; lat. 111–139 μ; lat. isthm. 17–23 μ.

M. pseudofurcata forms:—

Long. 150–153 μ; lat. 140–142 μ; lat. isthm. 15–16·5 μ.

40. M. Nordstedtiana, Wolle, Desm. U.S. p. 113, pl. 52. figs. 3–5.

Long. 134–191 μ; lat. 115–171 μ; lat. isthm. 14–27 μ. (Pl. XIV. fig. 4.)

After carefully noting many specimens of this we find that the "short conical prominence" on the middle of each side of the exserted neck of the polar lobe varies from a small conical prominence to short processes similar to the shorter ones at the apex of the polar lobe, but only two thirds their length, and furnished at the apex with from 1 to 3 small spines. Some specimens had these lateral projections doubled.

41. M. muricata, Bail.; Wolle, Desm. U.S. p. 118, pl. 36. figs. 4–7.

Specimens of this were observed in which the central one of the three basal processes on each side was again divided in the plane of the *Micrasterias* (long. 163–172 μ; lat. 100–104 μ; lat. isthm. 18–20 μ). (Pl. XIV. figs. 5, 6.)

Var. TUMIDA, nov. var. (Pl. XIV. fig. 7.) Var. semicellulis tumore basali utrobique ad medium; a basi visis processibus lateralibus brevioribus et subincurvatis; isthmo circulari.

Long. 195 μ; lat. 122 μ; crass. 37·5–40 μ; lat. isthm. 16·5 μ.

This variety differs from the typical form in having a central protuberance near the base of each semicell. This is most readily seen from the basal view of a semicell or from the lateral view. The isthmus is also circular and not elliptic.

42. MICRASTERIAS APICULATA, Menegh. in Linnæa, xiv. (1840) p. 216; Cooke, Brit. Desm. p. 186, pl. 48. fig. 1 [after W. B. Turner]. (*Euastrum apiculatum*, Ehrenb. Infus. p. 167, t. 12. fig. 2.) (Pl. XIV. fig. 12.)

Long. 228 μ; lat. 226 μ; lat. isthm. 30 μ. Lat. : long. = 1 : 1·004.
„ 254 μ; „ 226 μ; „ „ 35 μ. „ „ = 1 : 1·124.
„ 294 μ; „ 250 μ; „ „ 36 μ. „ „ = 1 : 1·176.

As the figure of this species given by Wolle (Alg. U.S. pl. 56. fig. 3) is so widely different from any forms with which we are acquainted, we give a figure of the American form we meet with, which differs from the European form only in being rather wider; we propose that the form figured by Wolle be named var. *Wollei*.

Subsp. FIMBRIATA, Nordst., var. SPINOSA, Biss. (Roy et Biss. in Ann. Scot. Nat. Hist. (1893) p. 173, pl. 1. fig. 3).

This seems to be one of a series of forms connecting *M. apiculata* with *M. fimbriata*.

43. M. RADIOSA, Ralfs, Brit. Desm. p. 72, t. 8. fig. 3.

Var. ORNATA, Nordst. in Vidensk. Meddel. 1869 (1870), p. 223, t. 2. fig. 11.

Long. 112 μ; lat. 110 μ; lat. isthm. 16 μ.

Hab. Minneapolis, Minnesota.

Var. SWAINII, nobis. (*Micrasterias Swainii*, Hastings, in Wolle, Desm. U.S., new edit. p. 119, pl. 42. fig. 1.)

We consider that *M. Swainii*, Hastings, is but a variety of this very variable species. We give a figure (Pl. XIII. fig. 30) of a form (long. 150 μ, lat. 151 μ, lat. isthm. 11·5 μ) sufficiently near his to show this, although the polar lobe of this example is abnormally narrow compared with other American specimens; the latter generally possess a broader polar lobe than British examples.

44. M. SPECIOSA, Wolle, Alg. U.S. p. 38, pl. 56. figs. 1, 2.

The typical form of this has the short peripheral spines set on like those of *M. apiculata*, Menegh., as one would infer from Wolle's description, though his figure does not show this.

Long. 144–153 μ; lat. 132–135 μ; lat. isthm. 16–21 μ.

Forma laciniis periphericis mucronatis (non spiniferis); membrana granulato-punctata.

Long. 150–154 μ; lat. 125–132 μ; lat. isthm. 15–22 μ. (Pl. XIV. figs. 10, 11.)

This form, so far as we have observed, always has the ultimate divisions of the lateral lobes subacute and submamillate; this also applies to the 6 "mucros" of the polar lobe in

some specimens; in others the polar lobe has 8 or more apical teeth, and these examples have this lobe also bordered with small spines. No small spines were seen on any of the lateral lobes of this form, and all the specimens seen had a strongly and densely punctate (minutely granulate) membrane.

45. MICRASTERIAS CONFERTA, Lund. Desm. Suec. p. 14, t. 1. fig. 5.

Var. HAMATA, Wolle, Desm. U.S. p. 114, pl. 38. figs. 3, 4. (*M. hamata*, Bœrg. in Vidensk. Meddel. 1890 (1891) p. 31.) (Pl. XIV. figs. 8, 9.)

Long. 80–86 μ; lat. 75–80 μ; lat. isthm. 10·5–11·5 μ.

Bœrgesen elevates this to the rank of a species on account of the peculiar polar lobe and the deeper and wider incisions. The incisions of the examples we have seen are certainly as narrow as those of Lundell. Wolle's figures also show the incisions quite as narrow as those of the latter, although Bœrgesen states in his note on *M. hamata*—"incisuras multo profundiores et ampliores." The incisions in Wolle's figures are deeper than those of the typical plant, as are those in some of the specimens we have seen, but in others that have come under our observation they were no deeper. The ultimate division of the lobes had two short spines rather than papillæ. Thus the chief character of this variety is in the form of its polar lobe, which difference is not sufficient to separate it as a distinct species from *M. conferta*.

All the specimens seen by us had the angles of the polar lobe more uncinate, so as to bring the apices of the angles *within* the margin of the frond. The exterior margin of each wing of the polar lobe has three teeth, and also has a pair of smaller teeth on each side of the median depression. The membrane is either minutely punctate or faintly scrobiculate.

46. M. THOMASIANA, Arch. in Quart. Journ. Micr. Sc. vol. ii. (1862) p. 239, t. 12. figs. 1–5.
Long. 271 μ; lat. 230 μ; lat. isthm. 28 μ. Lat. : long.=1 : 1·178.

47. M. ABRUPTA, nov. sp. (Pl. XIV. fig. 13–16.) *M.* parva, profunde constricta, sinu sublineari et subaperto; semicellulæ late truncato-semicirculares et quinquelobæ, lobo polari late triangulari incisuris subapicalibus apertis (interdum admodum curvatis basin versus semicellularum), apicibus rectis (interdum leviter truncato-convexis), angulis profunde emarginatis (interdum non emarginatis sed apiculatis), lobis lateralibus truncatis medio distincte emarginatis, angulis duobus apiculatis; a vertice visæ subangulari-fusiformes, polis acutis; a latere visæ angulari-ovatæ; membrana glabra vel punctata.

Long. 40–43 μ; lat. 42–49 μ; lat. isthm. 7·5–10 μ; crass. 12·5 μ.

Many examples of this were seen, and the characters were constant. The *M. truncata* figured by Wolle, Desm. U.S. pl. 38. fig. 9, may belong to this species.

Genus EUASTRUM, Ehrenb.

48. E. GIGANTEUM, Nordst. in De Toni, Syll. Alg. i. p. 1106. (*Tetmemorus giganteus*, H. C. Wood; Wolle, Desm. U.S. p. 92, pl. 20. fig. 6; Alg. U.S. p. 34, pl. 54. fig. 1.)

We have examined a large number of specimens of this plant, and from the character

of the sinus, the apical incision, the basal protuberances, and the thickened angles it must of necessity be placed under the genus *Euastrum*. As it has only been imperfectly described, we append the following amended description :—

E. permagnum, circiter $3\frac{1}{2}$-plo longius quam latius, modice constrictum, sinu lineari; semicellulæ longitudinaliter oblongæ; angulis inferioribus rectangularibus et levissime rotundatis, lateribus leviter convexis, vel convexis in parte inferiore et concavis in parte superiore, vel concavis in parte inferiore et convexis in parte superiore, apicibus subrotundatis vel truncatis cum angulis rotundatis, interdum apices versus subito attenuatis, incisurâ medianâ profundâ et angustissimâ, intra angulos inferiores tumore, supra isthmum tumore instructâ; a latere visæ lingui-formæ, angulis basalibus rectangularibus et levissime rotundatis, apicibus rotundatis; membrana scrobiculata; angulis inferioribus et incisuris apicalibus valde incrassatis.

Long. 248–251 μ; lat. 73–77 μ; lat. isthm. 32–34·5 μ; crass. 73 μ.

49. EUASTRUM CRASSUM, Kuetz.; Ralfs, Brit. Desm. p. 81, t. 11. fig. 3.

Var. SCROBICULATUM, Lund. Desm. Suec. p. 18, t. 2. fig. 1.

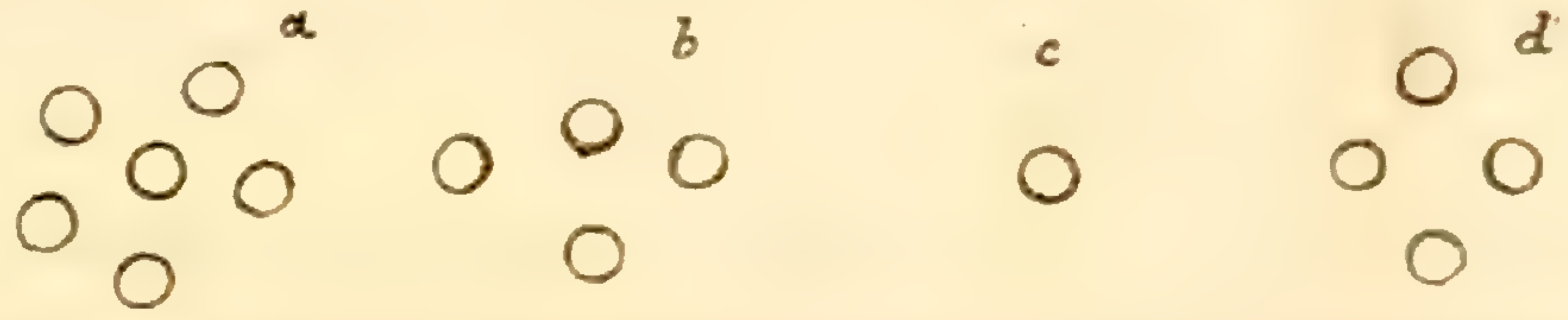


Fig. 1.—*Euastrum crassum* var. *scrobiculatum*, Lund.—Central scrobiculations. 520/1.

Lundell describes the scrobiculations as one or two; they vary in the American examples we have seen from one to six. (Fig. xylogr. 1.)

50. E. OBLONGUM, Ralfs, Brit. Desm. p. 80, t. 12.

Forma SCROBICULATA, Nordst. Sydlig. Norges Desm. p. 7.

The scrobiculations of this form are much smaller than those in the var. of *E. crassum*; the number in the centre of each semicell is one or two in the American specimens examined.

51. E. INSIGNE, Hass. Brit. Freshw. Alg. p. 21, t. 41. fig. 2; Ralfs, Brit. Desm. p. 83, t. 13. fig. 6. (Pl. XIV. fig. 17.)

Long. 133 μ; lat. 69–75 μ; lat. isthm. 17 μ; crass. 36 μ.

Typical examples of this were frequently observed; we note this because the figures given by Wolle (Desm. U.S. pl. 27. figs. 39–43) do not represent the species, but are probably *E. orientale*, W. B. Turn. Before we had seen the remarks under the last-named species by Turner (Freshw. Alg. of E. India, p. 79) we had written a long note practically embodying the same conclusions concerning *E. mamillosum*, Wolle, Desm. U.S. p. 102, pl. xxvi. figs. 14, 15.

52. E. INTERMEDIUM, Cleve, in Öfvers. Sv. Vet.-Akad. Förh. 1863 (1864), n. 10, p. 484, t. 4. fig. 1; Lund. Desm. Suec. p. 21, t. 2. fig. 4. (Pl. XIV. figs. 18, 19.)

Long. 60–66 μ; lat. 38·5–42 μ; lat. isthm. 7·5–8 μ; crass. 16·5–18·5 μ.

This species is not unfrequent, but has not been placed on record for the U.S., as that which was described and figured by Wolle (Desm. U.S. p. 102, pl. 24. fig. 1–5) is now known as *E. Wollei*, Lagerh.

53. Euastrum attenuatum, Wolle, Desm. U.S. p. 103, pl. 26. fig. 17. (*E. Hastingsii*, Wolle, Desm. U.S., new edit. p. 113, pl. 42. figs. 16, 17, et Wolle in lit. cum icone.) (Pl. XIV. figs. 20, 21.)

Having seen a large number of specimens of this species, we feel confident that the above two species of Wolle are the same; and as neither his figures nor descriptions under either name represent this characteristic species, we feel it necessary to describe and figure the true plant.

E. mediocre, subduplo longius quam latius, profunde constrictum, sinu lineari; semicellulæ trilobæ, angulis inter lobos rectangularibus et rotundatis, lobis lateralibus retusis, lobulis sæpe leviter emarginatis, iis inferioribus projicientioribus, lobis polaribus elongatis ($1\frac{2}{3}$-plo longioribus quam latis), lateribus levissime divergentibus, apicibus levibus et subtruncatis cum angulis rotundatis, infra et juxta apicem plicatis; intra lobos laterales (inter lobulos) tumore singulo et in centro semicellulæ tumoribus binis verticaliter dispositis instructis; a vertice visæ ellipticæ tumore singulo ad apicem unumquemque et lateribus tumoribus tribus utrobique, lobo polari circulari et crenulato; a latere visæ partibus inferioribus subrectangulares lateribus retusis, tumoribus 4 intus cruciatim dispositis, lobis polaribus ut a fronte visis.

Long. 61–63 μ; lat. 36·5–38·5 μ; lat. lob. pol. 11–11·5 μ; lat. isthm. 11·5–13·5 μ; crass. 21–22 μ.

The lateral lobes are not rectangular as figured by Wolle, but in all the specimens the margins converge somewhat, so that the upper lobule does not project so much as the lower one. The polar lobe is about the same length as in Wolle's figure of *E. attenuatum*, but certainly longer than that figured for *E. Hastingsii*. The apex is perfectly smooth (and is not crenulate as figured by Wolle for both *E. attenuatum* and *E. Hastingsii*); the longitudinal plications are on a dilated portion just below the apex, which gives a somewhat crenulated appearance to the apex when the plant is slightly tilted.

54. E. evolutum, nobis. (Pl. XIV. fig. 22.)

E. abruptum, Nordst., var. *evolutum*, Nordst. in Öfvers. Sv. Vet.-Akad. Förh. (1877) n. 3, p. 21, t. 2. fig. 7.

E. Nordstedtianum, Wolle (ex parte), Desm. U.S. pl. 26. figs. 7, 9, 11, 12.

This species is an abundant one in the material we have examined; although it is somewhat variable, its distinctive characters are always retained.

Above the denticulate protuberance on each side of the polar lobe there is always a stout spine, which, however, varies much in length; the lower of the two divisions of the lateral lobes is always the larger, and usually has a few more teeth. On each side of the sinus there is always present a large granule; above the central protuberance there are two very distinct scrobiculations, and within the margin on each side of the polar lobe there is always a rounded or emarginate wart.

The figures given by Wolle for *E. Nordstedtianum* are evidently intended to represent

this plant, but do so very inaccurately, if we may be allowed to judge by the materia received from him, in which it was abundant. His fig. 13 (pl. 26) does not represent this species in any position, and the lateral and vertical views given by him on pl. 52. figs. 13–15 are too diagrammatic.

Long. 60–66 μ; lat. 37–46 μ; lat. isthm. 13·5–15 μ; lat. lob. pol. 30–32 μ; crass. 27·5–31 μ.

Var. INTEGRIUS, nov. var. (Pl. XIV. figs. 23–25.) Var. lobo polari cum spinâ singulâ utrobique infra spinam majorem, incisurâ infra lobum polarem majore et latiore, lobis lateralibus non divisis sed subretusis, quadridenticulatis.

Long. 52–61 μ; lat. 32·5–41 μ; lat. isthm. 9·5–10 μ; lat. lob. pol. 24–30 μ; crass. 22–27 μ.

We feel sure that this is but a variety of the above species, as they frequently occurred together and their surface-markings are precisely identical. *E. Glaziovii*, Bœrg. (in Vidensk. Meddel. 1890 (1891), p. 36, t. 3. fig. 23), very probably comes under this variety.

55. EUASTRUM OCULATUM, Bœrg. in Vidensk. Meddel. 1890 (1891) p. 36, t. 3. fig. 24.

Var. TONSUM, nov. var. (Pl. XIV. fig. 26.) Var. minor et brevior, lateribus sine denticulis, apicibus truncatis, incisurâ apicali minus profundâ, denticulis paucis intra apices.

Long. (sine spin.) 38·5 μ; lat. 24 μ; lat. isthm. 5·5 μ; crass. 17 μ.

56. E. ELEGANS, Kuetz. Phycolog. Germ. p. 135; Ralfs, Brit. Desm. p. 89, t. 14. fig. 7 *a–c*.

Var. SPINOSUM, Ralfs, l. c. fig. 7, *f*, *i*, *k*. (Pl. XIV. fig. 27.)

Long. 36–38·5 μ; lat. 22–23 μ; lat. isthm. 6–6·5 μ; crass. 13·5 μ.

A figure of a fine and constant form of this variety is given.

Var. ORNATUM, West, in Journ. Roy. Micr. Soc. (1892) p. 723, pl. 9. fig. 9.

Long. 45 μ; lat. 28 μ; lat. isthm. 10 μ; crass. 17·5 μ.

Var. BIDENTATUM, Naeg. (? *E. elegans* var. *speciosum*, Boldt, in Bihang Sv. Vet.-Akad. Handl. xiii. (1888) Afd. III. n. 5, p. 9, t. 1. figs. 10, 11.)

Diam. zygosp. sine spin. 40–42·5 μ, cum spin. 60–65 μ. (Pl. XIV. fig. 28.)

Several examples of this variety with zygospores were noticed from Orono, Maine; they agreed very well with the figure given by Bœrgesen, in Bot. Tidssk. xvii. (1890) p. 143, t. 6. fig. 2 *b*.

57. E. CIASTONII, Racib. in Rozpr. Akad. Krak. ser. II. ii. (1892) p. 384, t. 2. fig. 28.

Long. 38·5–44 μ; lat. 21–26 μ; lat. isthm. 4·5–5 μ; lat. apic. 17–19·5 μ; crass. 16–17 μ. (Pl. XIV. fig. 31.)

This is not an unfrequent American species.

58. E. SOLIDUM, nov. sp. (Pl. XIV. fig. 29.) *E.* parvum, paullo longius quam latius, profundissime constrictum, sinu angusto lineari extremo ampliato; semicellulæ

subtrilobæ, lobis lateralibus subrectangularibus, lateribus leviter divergentibus, angulis superioribus emarginatis, lobo polari latissimo truncato ad medium retuso, angulis subacutis; semicellulæ tumore mediano, intra marginem angulorum superiorum et inferiorum loborum lateralium granulo singulo instructæ, intra apicem granulis 4 instructæ; a vertice visæ oblongæ polis rotundatis, latere unoquoque prope polos papillâ singulâ instructæ, tumore truncato mediano utrobique; a latere visæ ovato-ellipticæ, apice subtruncato, tumore truncato infra medium utrobique.

Long. 27 μ; lat. 23 μ; lat. apic. 14·5 μ; lat. isthm. 4·5 μ; crass. 13·5 μ.

59. Euastrum subornatum, nov. sp. (Pl. XIV. fig. 30.) *E.* minimum, paullo latius quam longius, profunde constrictum, sinu lineari; semicellulæ subtrilobæ, lobis lateralibus rotundatis et granulatis, lobo apicali breviore late emarginato-truncato, apice levissime 4-undulato, in centro cum annulo granulorum 5 circa granulum centralem; a vertice visæ anguste oblongæ, in medio valde inflatæ (et trigranulatæ) utrobique polis angulari-capitatis et granulatis, lobo polari quadrato-oblongo; a latere visæ subtrilobæ, granulatæ, apicibus truncatis.

Long. 16·5–17·5 μ; lat. 19·5–22 μ; lat. apic. 8–10 μ; lat. isthm. 6–9 μ; crass. 13–5 μ.

60. E. validum, nov. sp. (Pl. XIV. figs. 32, 33.) *E.* parvum, 1⅓-plo longius quam latius, profundissime constrictum, sinu angusto-lineari extremo leviter ampliato; semicellulæ truncato-pyramidatæ, lateribus retusis, angulis inferioribus inflatis, angulis superioribus subrotundatis et leviter incrassatis, apicibus latis truncato-convexis retusis et leviter incrassatis in medio, intra angulos inferiores cum papillâ parvâ, supra et juxta isthmum cum granulo magno, in centro scrobiculo minuto; a vertice visæ ellipticæ cum papillâ parvâ ad polos utrobique; a latere visæ ovatæ, cum granulo juxta isthmum utrobique; membrana glabra.

Long. 28–30 μ; lat. 22 μ; lat. apic. 14·5 μ; lat. isthm. 4·5 μ; crass. 11 μ.

The nearest species to this is *Cosmarium subbinale*, Lagerh. in Nuova Notarisia (2 Genn. 1893), p. 163 (*C. Hammeri*, Reinsch, v. *subbinale*, Nordst. Freshw. Alg. of New Zeal. & Austr. p. 56, t. 6. fig. 7).

Some considerable time after the above was written *Cosmarium międzyrzecense*, B. Eichl. & Gutw. (Nonn. Alg. Nov. (1894) p. 4, t. 4. fig. 9), has been described and figured. It comes very near the above species in front view, but it is much smaller, relatively longer, has a different apex, and is without the small granules present within the basal angles of *E. validum*; the vertical view is also quite different.

61. E. trigibberum, West & G. S. West, in Trans. Linn. Soc. ser. II., Bot. v. (1895) p. 53, pl. 6. fig. 22.

Long. 26·5–29 μ; lat. 22–23 μ; lat. lob. pol. 14·5–15·5 μ; lat. isthm. 7 μ; crass. 13–5 μ. (Pl. XIV. fig. 34.)

The specimens observed were a little larger than those seen from Madagascar, but were otherwise almost identical with them.

Genus Cosmarium, Corda; Ralfs.

62. C. Hammeri, Reinsch, Algenfl. Franken, p. 111, t. 10. fig. 1. (*C. homalodermum*, Nordst. in Öfvers. Sv. Vet.-Akad. Förh. (1875) n. 6, p. 18, t. 6. fig. 4.)

Var. PROTUBERANS, n. var. (Pl. XIV. fig. 35.) [*C. Hammeri* var. "with inflated sides," Wolle, Desm. U.S. pl. xviii. figs. 36–38.] Var. semicellulis a vertice visis tumore mediano utrobique. Zygospora globosa aculeis simplicibus (multo latioribus ad basin) instructa.

Long. 35 μ; lat. 21·5 μ; lat. isthm. 7·5 μ; crass. 12·5 μ; diam. zygosp. sine spin. 30 μ, cum spin. 46 μ.

Wolle figures a zygospore of this variety with numerous *furcate* spines (*l. c.* fig. 38).

63. COSMARIUM GRANATUM, Bréb. in Ralfs, Brit. Desm. p. 96, t. 32. fig. 6.

Var. OCELLATUM, nov. var. (Pl. XV. fig. 19.) Var. semicellulis scrobiculo singulo in centro, a latere visis scrobiculo singulo utrobique supra medium; membrana forte punctata.

Long. 44 μ; lat. 28 μ; lat. isthm. 6 μ; crass. 17 μ.

Compare with *C. pseudogranatum*, Nordst. in Vidensk. Meddel. 1869 (1870) p. 211, t. 3. fig. 27.

64. C. INÆQUALIPELLICUM, West & G. S. West, in Trans. Linn. Soc. ser. II., Bot. v. (1895) p. 54, pl. 6. figs. 28, 29.

Long. 24–25·5 μ; lat. 17–19 μ; lat. isthm. 5 μ; crass. 10·5 μ.

65. C. BAILEYI, Wolle Desm. U.S. p. 64, pl. xvi. figs. 17, 18. (*C. depressum*, Bail. *non* Naeg.)

Var. MAJOR, nov. var. (Pl. XIV. fig. 36.) Var. duplo-major, profundius constrictum, semicellulis subangularibus, lateribus rectioribus; a vertice visis elliptico-rhomboideis polis subrotundatis; pyrenoidibus binis.

Long. 69–73 μ; lat. 76–79 μ; lat. isthm. 17·5 μ; crass. 32·5 μ.

We consider that this agrees sufficiently well with the above species, although it is so much larger, is somewhat angular, and has a narrower isthmus. The plant has two distinct pyrenoids in each semicell, though Wolle in his remarks under *C. obsoletum*, Reinsch, leaves you to infer that *C. Baileyi* has but one. This variety can be compared with *C. circulare* Reinsch (Algenfl. Franken, p. 108, t. 10. fig. 2). It may also be the *C. obsoletum*, Wolle (Desm. U.S. p. 64, p. 49. fig. 12), which certainly does not agree with *C. obsoletum*, Reinsch.

66. C. PSEUDOPYRAMIDATUM, Lund. Desm. Suec. p. 41, t. 2. fig. 18.

Long. zygosp. 42·5–44 μ; lat. zygosp. 32–34·5 μ. (Pl. XV. fig. 2.)

Several zygospores of this were noted and they were all elliptical, the surface being covered with large rounded warts; Wolle's figure is that of a circular one.

67. C. DOLIFORME, nov. sp. (Pl. XV. fig. 16.) *C.* parvum, subduplo longius quam latius, modice constrictum, sinu angusto-lineari extremo subampliato; semicellulæ truncato-pyramidatæ lateribus levissime convexis et basin versus levissime retusis, prope apices leviter constrictis, apicibus retusis; a vertice visæ late ellipticæ; a latere visæ ovato-ellipticæ; membrana sparse et delicatissime punctulata.

Long. 33 μ; lat. 18 μ; lat. isthm. 9 μ; crass. 10 μ.

This at first sight seems near to forms of *C. pseudopyramidatum*, Lund., but is much smaller, more angular, less deeply constricted, and has a different membrane.

68. COSMARIUM SUBDEPRESSUM, nov. sp. (Pl. XV. fig. 15.) *C.* parvum 1⅓-plo latius quam longius, profundissime constrictum, sinu angusto-lineari extremo ampliato; semicellulæ multo depressæ latissime reniformes; a vertice visæ oblongæ, lateribus rcetis et polis rotundatis; a latere visæ circulares; membrana minutissima punctato-granulata, pyrenoidibus binis.

Long. 15–16 μ; lat. 21–22 μ; lat. isthm. 3·7 μ; crass. 7·5 μ.

This differs from *C. depressum*, Lund. (Desm. Suec. p. 38; *Euastrum depressum*, Naeg. Gatt. einzell. Alg. p. 114, t. 7 c. fig. 2), in being much smaller and more depressed, in having a narrower and deeper sinus, in its narrowly oblong vertical view, in its binate pyrenoids, as well as in its very minutely granular membrane, which gives the outline a very faintly rough appearance.

69. C. SINOSTEGOS, Schaarschm. in Magyar Tudom. Akad. Közlem. xviii. (1882) p. 266, fig. 12.

Var. OBTUSIUS, Gutw. in Nuova Notarisia (5 Apr. 1892) p. 21; et in Sprawozd. Akad. Krak. xviii. II. (1893) p. 129, t. 2. fig. 13.

Long. 9·6 μ; lat. 10·5 μ; lat. isthm. 3·6 μ; crass. 5·5 μ.

70. C. CLEPSYDRA, Nordst. in Vidensk. Meddel. 1869 (1870) p. 212, t. 2. fig. 29.

Long. 20–22·5 μ; lat. 20–22·5 μ; lat. isthm. 5 μ; crass. 17·5–70 μ.

A form of this was observed with the sinus a little more open and with a larger central inflation; the angles were also thickened and the membrane minutely punctulate. This species and *C. tithophorum*, Nordst. (Alg. et Char. i. p. 6, t. 16. fig. 6), seem to be closely allied, and the American form might easily be placed as a variety of the latter species. *C. tithophorum* forma *intermedia*, B. Eichl. & Gutw. (Nonn. Alg. Nov. 1894, p. 10, t. 5. fig. 31), seems to be nearer *C. Clepsydra*, but with the angles rounded off. *C. bicardia*, Reinsch, as figured by Borge, in Bihang Sv. Vet.-Akad. Handl. xix. (1894) Afd. III. n. 5, p. 31, t. 3. fig. 33, may possibly be a form of *C. tithophorum*, Nordst.

71. C. EXIGUUM, Arch. in Micr. Journ. (1864) p. 178, t. 6. figs. 32, 33; Cooke, Brit. Desm. p. 92, t. 43. fig. 4.

Var. PRESSUM, West, New Brit. Freshw. Alg., in Journ. Roy. Micr Soc. (1894) p. 6, pl. I. fig. 1.

Long. 16 μ; lat. 6·7 μ; lat. isthm. 3·8 μ; crass. 4·8 μ.

72. C. MINIMUM, West & G. S. West, in Trans. Linn. Soc. ser. II., Bot. v. (1895) p. 58, pl. 8. fig. 10.

Var. SUBROTUNDATUM, West (*l. c.* fig. 11).

Long. 7–7·7 μ; lat. 6–7 μ; lat. isthm. 3·5 μ; crass. 4 μ.

73. C. SUBIMPRESSULUM, Borge, in Bihang Sv. Vet.-Akad. Handl. xix. (1894) Afd. III n. 5, p. 27, t. 2. fig. 27.

Long. 36–38 μ; lat. 25·5–27 μ; lat. isthm. 6·5–7·5 μ; crass. 15·5 μ. (Pl. XV. fig. 18.)

Many examples of this species were seen, and they were quite constant and perfectly symmetrical (!).

C. impressum, Elfv., is a fairly common species in the United States of America.

74. COSMARIUM REGNELLII, Wille, in Bihang Sv. Vet.-Akad. Handl. viii. (1884) n. 18, p. 16, t. 1. fig. 34. (Pl. XV. fig. 20.)

Long. 14·5–17·5 μ; lat. 15·5–19 μ; lat. isthm. 5–5·5 μ.

This species was rather abundant, and was fairly typical, though the subapical notches were not so deep as figured by Wille.

75. C. SUBLATEREUNDATUM, West & G. S. West, in Trans. Linn. Soc. ser. II., Bot. v. (1895) p. 60, pl. 6. fig. 1.

Long. 42–46 μ; lat. 38·5–41 μ; lat. isthm. 12–13·5 μ.

The specimens were a little larger than the original ones, and had one more undulation on each side of the semicells.

76. C. CYATHIFORME, nov. sp. (Pl. XV. fig. 9.) *C.* submediocre, tam longum quam latum, profunde constrictum, sinu angusto-lineari extremo ampliato; semicellulæ subtrapeziformes, angulis inferioribus superioribusque leviter rotundatis, lateribus divergentibus et subrectis, apicibus valde convexis, granulis circ. 11 intra apicem (juxta marginem) et angulos superiores, infra eos serie granulorum majorum 5, et granulis multo minoribus circ. 5 subter iis; a vertice visæ ellipticæ polis truncatis, granulis magnis 5 utrobique et granulis 9 intra marginem unumquemque instructæ; a latere visæ cyathiformes apicibus truncatis, granulis tribus ad margines superiores et granulis (circ. 6) intra marginem superiorem utrobique; pyrenoidibus binis.

Long. 35 μ; lat. 34 μ; lat. isthm. 7·5 μ; crass. 21 μ.

This approaches both *C. hexagonum*, Nordst. in Vidensk. Meddel. 1869 (1870) p. 208, t. 3. fig. 18), and *C. insigne*, Schmidle, in Ber. naturf. Ges. Freib. i. Br. vii. (1893) p. 100, et in Flora, lxxviii. (1894) p. 56, but differs from them in the form of its cells and the arrangement of its granules.

77. C. ELOISEANUM, Wolle, Desm. U.S. p. 85, pl. 19. figs. 1, 2. (Pl. XV. fig. 22.)

Wolle has given a figure of this species which is quite inaccurate, and as his description is also incorrect we give both figure and amended description. In his Freshw. Alg. U.S. p. 33, he says that the figure he had drawn was an old form and had too many teeth; he should have said three times too many.

C. submagnum, $1\frac{1}{3}$–$1\frac{1}{2}$-plo longius quam latius, profunde constrictum, sinu angusto, extrorsum ampliato; semicellulæ late ellipticæ, margine serie dentium magnorum acuminatorum 25–28 [23–25 (Wolle, Alg. U.S.)], in centro incrassatæ et scrobiculis magnis ornatæ; a vertice visæ ellipticæ polis subtruncatis, ad medium utrobique tumore scrobiculato, seriebus duabus subrectis dentium de polo ad polum ornatæ; membrana luteola punctata.

Long. sine dent. 98 μ; cum dent. 111 μ; lat. sine dent. 62 μ, cum dent. 76 μ; lat. isthm. 25 μ; crass. 46 μ.

The teeth are rather suddenly attenuated, and the two series in vertical view are not

convex towards each other, but slightly concave. The central tumor is not so elevated, and is not granulate but scrobiculate.

Var. DEPRESSUM, nov. var. (Pl. XV. fig. 23.) Var. semicellulis depressis, sinu minus aperto extremo valde ampliato, apicibus subtruncatis, dentibus ad apicem paulo infra marginem positis, angulis inferioribus dentibus 5–6 intra marginem irregulariter dispositis.

Long. sine dent. 77–86 μ; lat. sine dent. 54–65 μ; cum dent. 63–73 μ; lat. isthm. 17–25 μ.

We have met with this variety much more often than with the type.

78. COSMARIUM DENTATUM, Wolle, Desm. U.S. p. 76, pl. 13. fig. 15. (Pl. XV. figs. 10, 11.)

We presume that Wolle has observed the same plant that we have seen; yet, as neither his description nor his figure represents the species correctly, we give both.

C. magnum, 1½-plo—subduplo longius quam latius, profunde constrictum, sinu aperto apice acuto; semicellulæ late ellipticæ vel subrotundæ, apicibus leviter subtruncatis [vel late rotundatis (Wolle)], lateribus dentibus subobtusis 10–12, aliis paucis intra marginem, in centro incrassatæ; a vertice visæ ellipticæ, ad medium utrobique valde incrassatæ, ad polos dentibus 3–4 et dentibus irregulariter ordinatis in zonâ de polo ad polum, in centro defectis; a latere visæ circulares vel late ellipticæ; membrana crassa luteola, minute scrobiculata, scrobiculis majoribus in parte centrali incrassata, inter scrobiculos minutissime et dense punctulata.

Long. 135–169 μ; lat. sine dent. 88–96 μ; lat. isthm. 31–33 μ; crass. 66–69 μ.

The membrane is finely scrobiculate and not "closely set with small pearly granules." Wolle states in his description that there are from 10 to 12 teeth on each lateral margin of the semicells; his figure shows 17 to 18, and these are figured proportionally too small.

79. C. OVALE, Ralfs, Brit. Desm. p. 98, t. 15. fig. 9.

Var. SUBGLABRUM, nov. var. (Pl. XV. fig. 3.) Var. granulis perpaucis, duobus (fere) ad angulum basalem unumquemque, 3–4 apices versus utrobique et 2–3 intra marginem prope apicem, apicibus anguste truncatis; membrana magis scrobiculata ut in formâ typicâ.

Long. 154 μ; lat. 88 μ; lat. isthm. 30 μ.

A common American form of this species has a slightly subtruncate and retuse apex, with the retuse portion without granules; in this respect it approaches var. *excisum*, Racib. in Pamiet. Akad. Krak. xvii. (1890) p. 91, t. 6. fig. 2.

80. C. BALTEUM, nov. sp. (Pl. XV. fig. 1.) *C.* submagnum, 1½-plo longius quam latius, profunde constrictum, sinu angusto-lineari extremo subampliato; semicellulæ truncato-pyramidatæ, lateribus convexis, angulis inferioribus superioribusque rotundatis, apicibus levissime convexis, margine granulato-undulatæ ad apicem granulis reductis, granulis magnis in seriebus concentrice 3 intra marginem (serie interiore majore), sinus versus granulis minoribus et subirregularibus; ad medium supra isthmum granulis parvis paucis in seriebus horizontalibus 4 dispositis; a vertice visæ ellipticæ, polis granulato-undulatis, de polo ad polum cum zonâ latâ granulorum

in lineis 11 ordinatorum, in centro granulis reductis, ad medium utrobique granulis paucis ornatæ (in margine circ. 5); a latere visæ ovatæ, apicibus subtruncatis, cum zonâ latâ verticali granulorum in lineis 11 (in seriebus horizontalibus 15) ordinatorum, ad basin utrobique granulatæ marginibus superioribus glabris; membrana punctata; pyrenoidibus binis.

Long. 88·5–103 μ; lat. 61·5–69 μ; lat. apic. circ. 22–27 μ; lat. isthm. 19–20 μ; crass. 44 μ.

Compare with *C. Eichleri*, Racib. (in Rozpr. Akad. Krak. ser. II. ii. (1892) p. 384, t. 1. fig. 7), and *C. supraspeciosum*, Wolle (Desm. U.S. p. 88, pl. 50. figs. 5, 6).

81. Cosmarium Favum, nov. sp. (Pl. XV. figs. 5, 6.) *C.* mediocre, $1\frac{1}{5}$-plo longius quam latius, profunde constrictum, sinu angusto-lineari extremo valde ampliato; semicellulæ transverse oblongo-ellipticæ, granulis in seriebus obliquis et subverticalibus ornatæ, cum sulculo rotundo-hexagono circa granulum unumquemque (cum punctulo ad angulum unumquemque), in centro cellulæ circa isthmum membrana glabra; a vertice visæ oblongo-ellipticæ.

Long. 69 μ; lat. 55·5–57·5 μ; lat. isthm. 19 μ; crass. 35 μ.

This species is nearest to *C. margaritatum*, Roy et Biss. in Journ. Bot. xxiv. (1886) p. 194; et in Ann. Scot. Nat. Hist. (1894) p. 167, pl. 2. fig. 12, but differs in its more rounded semicells and different ornamentation.

82. C. subpulchellum, nov. sp. (Pl. XV. fig. 12.) *C.* submediocre, paulo longius quam latius, modice constrictum, sinu angusto-lineari extremo ampliato; semicellulæ transverse oblongæ lateribus rotundatis, apicibus late truncatis et levissime concavis, dense et minute granulatæ, granulis irregulariter ordinatis, in centro glabræ; a vertice visæ anguste oblongæ, polis rotundatis; a latere visæ ellipticæ.

Long. 47 μ; lat. 44 μ; lat. isthm. 15 μ; crass. 16 μ.

This differs from *C. pulchellum*, W. B. Turn. (Freshw. Alg. of E. India, p. 66, t. 9. fig. 46), in the depressed subconcave apices, in the irregular arrangement of the more numerous granules, which are absent at the centre of the semicells, and in the much narrower vertical and lateral views.

83. C. biauritum, Nordst. in Vidensk. Meddel. 1869 (1870) p. 212, t. 3. fig. 30. Forma granulis in medio semicellularum paulo reductis.

Long. 20 μ; lat. 15·5 μ; lat. isthm. 4·5 μ; crass. 10 μ.

84. C. abruptum, Lund. Desm. Suec. p. 43, t. 2. fig. 22.

Var. granulatum, West & G. S. West, in Trans. Linn. Soc. ser. II., Bot. v. (1895) p. 65, pl. 7. fig. 32. Forma paulo major et cellulis subquadratis.

Long. 17–19 μ; lat. 13·5–16 μ; lat. isthm. 4·5–5·5 μ; crass. 11·5 μ.

Hab. Orono, Maine.

85. C. cosmetum, nov. sp. (Pl. XV. fig. 4.) *C.* mediocre, paulo longius quam latius, profunde constrictum sinu angusto-lineari extremo ampliato; semicellulæ oblongo-trapeziformes, angulis inferioribus superioribusque rotundatis, lateribus convexis

granulis 8 utrobique instructis, apicibus subrectis et glabris, intra angulos basales granulis parvis 2–3, infra apices et intra angulos superiores medium tenus cum granulis magnis in seriebus verticalibus et obliquis (circiter 4 obliquis), cum depressionibus triangularibus 6 circa granulum unumquemque; a vertice visæ elliptico-oblongæ, polis subtruncatis granulis parvis paucis instructis, lateribus granulis magnis (circ. 10) instructis, intra polos et latera granulis ordinatis, in centro glabræ; a latere visæ subcirculares, apicibus pæne glabris, lateribus granulis magnis 5 ornatis.

Long. 51–57 μ; lat. 44–48·5 μ; lat. isthm. 12·5–15 μ; lat. apic. 22 μ; crass. 33 μ.

This has a very similar outline to *C. confusum*, Cooke, **ambiguum*, West, in Journ. Linn. Soc. (Bot.) xxix. (1892) p. 156, pl. 21. fig. 13, but differs altogether in its ornamentation, which also distinguishes it from *C. trachypleurum*, Lund., and its varieties, as well as from *C. subtholiforme*, Racib., var. *Malinvernianum*, Racib. in Pamiet. Akad. Krak. xvii. (1890) p. 91, t. 1. fig. 40.

86. Cosmarium amœnum, Bréb. in Ralfs, Brit. Desm. p. 102, t. xvii. fig. 3.

Var. compactum, nov. var. (Pl. XV. fig. 13.) Var. cellulis multo brevioribus et latioribus, granulis in seriebus 8 verticalibus ordinatis.

Long. 40 μ; lat. 27 μ; lat. isthm. 13·5 μ; crass. 17 μ.

87. C. ordinatum, nobis. (Pl. XV. fig. 14.) [*C. brasiliense*, Nordst., **ordinatum*, Bœrg. in Vidensk. Meddel. 1890 (1891) p. 40, t. 4. fig. 32.

Long. 22 μ; lat. 19·5 μ; lat. isthm. 6·5 μ.

88. C. Boeckii, Wille, Norges Ferskv. Alg. p. 28. t. 1. fig. 10.

Forma. (Pl. XV. fig. 7.)

Long. 32·5–33 μ; lat. 29·5–32·5 μ; lat. isthm. 8–8·5 μ; crass. 18 μ.

This is a common American form of this species, and differs somewhat from Wille's in the arrangement of its central granules. Wolle's figure has too many granules along the margins and is otherwise inaccurate.

89. C. taxichondrum, Lund. Desm. Suec. p. 39, t. 2. fig. 13.

Var. angulatum, nov. var. (Pl. XV. fig. 8.) Var. cellulis late hexagonis, semicellulis lateribus subrectis sed leviter undulatis, granulis tribus intra apices truncatos et granulo singulo juxta isthmum; a vertice visis polis emarginatis; membrana minute scrobiculato-punctata.

Long. 25 μ; lat. 31 μ; lat. isthm. 6·5 μ; crass. 13·5 μ.

The following is a list of the many varieties of this and other allied species:—

Cosmarium taxichondrum, Lund., var. *subundulatum*, Boldt.
" " " " " f. *subdenticulatum*, West.
" " " var. *emarginatum*, West.
" " " var. *compressum*, West.
" " " var. *dentatum*, West.
" " " var. *bidentulum*, Lagerh.
" " " var. *lithuanicum*, Racib.
" " " var. *nudum*, W. B. Turn.

Cosmarium taxichondriforme, B. Eichl. & Gutw.
„ *Haynaldii,* Schaarschm.
„ *decachondrum,* Roy et Biss.
„ *pseudotaxichondrum,* Nordst.
„ „ **trichondrum,* Lagerh.
„ „ „ var. *quadridentulum,* Lagerh.
„ *notochondrum,* West.
„ *pileigerum,* Lagerh.

90. Cosmarium contractum, Kirchn. Algenfl. Schles. p. 147.

Var. maximum, nov. var. Var. duplo-major quam forma typica.

Long. 84–88·5 μ; lat. 61–62 μ; lat. isthm. 17–20 μ; crass. 52 μ.

A number of examples of this variety were observed; no intermediate forms between it and the type were noticed.

Var. papillatum, nov. var. (Pl. XV. fig. 21.) Var. multo majus, sinu apertiore ad apicem, semicellulis papilla elongata singula ad medium lateris uniuscujusque.

Long. 73 μ; lat. sine papill. 51 μ; long. papill. 2-3 μ; lat. isthm. 20 μ; crass. 44 μ.

91. C. globosum, Bulnh. in Hedwigia, ii. (1863) p. 52, t. 9. fig. 8.

Var. Wollei, nov. var. (Pl. XV. fig. 17.) (*C. globosum,* Wolle, Desm. U.S. p. 60, pl. 49. figs. 15–17.) Var. minus profunde constrictum, sinu apertiore; semicelluli saltioribus, parte basin versus latissimâ; membrana scrobiculato-punctata. Zygospora depresso-globosa et glabra.

Long. 38·5 μ; lat. 24 μ; lat. isthm. 21 μ; long. zygosp. 34 μ; lat. zygosp. 28 μ.

92. C. palangula, Bréb. in Ralfs, Brit. Desm. p. 212; Rabenh. Fl. Europ. Alg. iii. p. 174.
Long. 32·5 μ; lat. 13·5 μ; lat. isthm. 11·5 μ.

Genus Xanthidium, Ehrenb.

93. X. antilopœum, Kuetz. Spec. Alg. p. 177. (*Cosmarium antilopœum* Bréb. in Linnæa, xiv. (1840) p. 218; *X. fasciculatum,* Ralfs, Brit. Desm. (ex parte) t. 20. fig. 1 *a, c.*)

Many forms of this were met with: var. *polymazum,* Nordst., was abundant; var. *minneapoliense,* Wolle (Desm. U.S. p. 94, pl. 52. fig. 16), was noticed with the median subapical spine arising from both above and below the granules (fig. xylogr. 2). Another form of the last variety had either one or two pairs of subapical spines and no granules.

A peculiar form without any central granules, and which had two pairs of spines on each side of the semicells arising very near each other, the upper pair being vertical, the lower almost horizontal. Long. s. spin. 61 μ, c. spin. 86 μ; lat. s. spin. 57 μ, c. spin. 92 μ; lat. isthm. 14·6 μ.

A few peculiar examples of a *Xanthidium* were observed, which we think must be placed under *X. antilopœum,* though some of them appeared to be near *X. cristatum* without the basal spines. The spines were somewhat irregular and single ones often replaced the pairs. Long. s. spin. 36·5 μ, c. spin. 55 μ; lat. s. spin. 31 μ, c. spin. 52 μ; lat. isthm. 7·6 μ; crass. 20 μ. (Pl. XVI. fig. 1.)

Var. CANADENSE, Josh. in Journ. Bot. xxiv. (1885) p. 34, t. 254. fig. 5. (Pl. XVI. fig. 2.)

Long. s. spin. 85 μ, c. spin. 110 μ; lat. s. spin. 61–62·5 μ, c. spin. 89–97 μ; lat. isthm. 18·5 μ; crass. s. spin. 50 μ, c. spin. 75–80 μ.

The form seen by us was very symmetrical, with straight spines; the vertical view was subhexagonal.

Var. JOHNSONII, nov. var. (*X. antilopæum*, var., N. L. Johnson, in Bull. Torr. Bot. Club, xxvii. (1894) p. 289, pl. 211. fig. 1.)

This form has been noticed by us frequently.

Fig. 2.

Fig. 3.

Fig. 2.—*Xanthidium antilopæum*, var. *minneapoliense*, Wolle.—Central spine and granules. 520/1.
Fig. 3.—*Xanthidium cristatum*, var. *uncinatum*, Bréb.—Central granules. 520/1.

94. XANTHIDIUM CRISTATUM, Bréb. in Ralfs, Brit. Desm. p. 115, t. 19. fig. 3 *a–c*.

An illustration is given of the variability of the central granules of var. *uncinatum*, Bréb. (fig. xylogr. 3).

One rather abundant American form of this species is that described and figured by W. B. Turner (Freshw. Alg. of E. India, p. 99, t. 12. fig. 28) as "*X. bisenarium*, Ehrenb. (=*X. cristatum*, var. *uncinatum*) var. *rotundatum*, Turn."

95. X. FASCICULATUM, Ehrenb.; Ralfs, Brit. Desm. ex parte t. 19. fig. 4.

Var. ORONENSE, nov. var. (Pl. XV. fig. 25.) Var. semicellulis semicircularibus, spinis brevioribus, ad angulos inferiores spinis interdum tribus et intra angulos inferiores papillâ instructis.

Long. s. spin. 57·5 μ, c. spin. 71 μ; lat. s. spin. 48 μ, c. spin. 61 μ; lat. isthm. 14·5 μ; crass. 25 μ.

Hab. Orono, Maine.

96. X. TETRACENTROTUM, Wolle, Desm. U.S. p. 95, pl. 22. figs. 8, 9. (Pl. XV. fig. 24.)

A specimen of this was seen that had but a single spine at one of the basal angles; it exactly agreed in the form of its front and vertical views with *Arthrodesmus incrassatus*, Lagerh. in Öfvers. Sv. Vet.-Akad. Förh. (1885) n. 7, p. 242, t. 1. fig. 18); his *Arthrodesmus*, however, has but one spine at each of the basal angles; yet we consider it is but a form of this *Xanthidium*, as the thickened scrobiculate portion in the centre of the semicells was the same in our plant as in his.

Long. 41 μ; lat. s. spin. 36·5 μ, c. spin. 54–57 μ; lat. isthm. 12 μ; crass. 23 μ.

Another example had one semicell bearing but a single spine on each side; the other

semicell was deformed and also had one incipient spine at one side; this certainly belonged to the same species as the one bearing two spines on each side.

Long. 35 μ; lat. s. spin. 32 μ, c. spin. 47 μ; lat. isthm. 10 μ.

Xanthidium quadricornutum, Roy et Biss. (in Ann. Scot. Nat. Hist. (1893) p. 245, pl. 4. fig. 5), seems to us very near this species.

Genus Arthrodesmus, Ehrenb.

97. A. convergens, Ehrenb. Infus. p. 152, t. 10. fig. 18; Ralfs, Brit. Desm. p. 118, t. 20. fig. 3.

One zygospore (diam. 39 μ) of this species was seen from Scarbro', Maine. (Pl. XV. fig. 3.) The spines of the species are always incurved as well as convergent, and not so straight as Wolle figures them.

Var. incrassatus, Gutw. in Sprawozd. Akad. Krak. xxvii. ii. (1892) p. 64, t. 3. fig. 5. (Pl. XVI. fig. 4.)

Long. 33 μ; lat. s. spin. 31·5 μ, c. spin. 51 μ; lat. isthm. 7·5 μ; crass. 17 μ.

The form seen has the incrassations much more marked. They consist of two transverse bars within each semicell near the apex, and are best seen in lateral view as two thickenings.

Var. obesum, nov. var. (Pl. XVI. fig. 5.) Var. semicellulis a fronte et a vertice visis late ellipticis, spinis longioribus.

Long. 44·5 μ; lat. s. spin. 32·5 μ, c. spin. 63 μ; lat. isthm. 9·5 μ; crass. 24 μ.

98. A. subulatus, Kuetz. Spec. Algar. p. 176.

Long. 46 μ; lat. s. spin. 38·5 μ, c. spin. 98 μ; lat. isthm. 10 μ.

One form of this is worth mentioning as being similar to that figured by Wolle (Desm. U.S. pl. xxiv. fig. 11), with a higher back, and longer, straighter spines, than the typical form.

99. A. curvatus, W. B. Turn. Freshw. Alg. of E. India, p. 135, t. 11. fig. 33, t. 12. figs. 2, 8.

Long. 50 μ; lat. s. spin. 54 μ, c. spin. 100 μ; lat. isthm. 13·5 μ.

Genus Staurastrum, Meyen; Ralfs.

100. S. apiculatum, Bréb. Liste Desm. p. 142, t. 1. fig. 23; Cooke, Brit Desm. p. 139. Zygosporæ globosæ, aculeis longis tenuibus rectis numerosis obsessæ.

Diam. zygosp. s. spin. 23 μ, c. spin. 35 μ. (Pl. XVI. fig. 6.)

The zygospores we observed of this species had numerous rather fine and very sharp spines, in all respects very similar to those described for the zygospores of *S. dejectum*, Bréb., and not to those described for *S. apiculatum*. There is much in this species common with *S. dejectum*, and as their zygospores so much resemble one another, the two are hardly separable as distinct species, and Lundell (Desm. Suec. pp. 59–60) was probably correct in placing *S. apiculatum* as a variety of *S. dejectum*.

101. Staurastrum connatum, Roy et Biss. in Journ. Bot. xxiv. (1886) p. 237. (*S. dejectum*, Bréb., var. *connatum*, Lund. Desm. Suec. p. 60, t. 3. fig. 28.)

Var. americanum, nov. var. (Pl. XVI. fig. 7.) Var. semicellulis paulo longioribus et angustioribus, spinis erectioribus longioribus, curvatis et validioribus.

Long. sine spin. 24 μ, cum spin. 48 μ; lat. (s. spin.) 19·5 μ; lat. isthm. 6 μ.

S. hexacanthum, F. Gay (in Rev. Sc. Nat. sér. III. iii. (1883) p. 303, t. 6. fig. 9), and f. *intermedia*, B. Eichl. & Gutw. (Nonn. Alg. Nov. 1894, p. 15, t. 5. fig. 54), seem to us to be but forms of *S. connatum* with thicker spines.

102. S. Dickiei, Ralfs, Brit. Desm. p. 123, t. 14. fig. 23.

Var. circulare, W. B. Turn. Freshw. Alg. of E. India, p. 105, t. 16. fig. 5. Forma *major*, W. B. Turn. (*l. c.*).

Long 42–44 μ; lat. 41–43 μ; lat. isthm. 9·5–10·5 μ.

Var. maximum, West & G. S. West, in Trans. Linn. Soc. ser. II., Bot. v. (1895) p. 72, pl. 8. fig. 19. (Pl. XVIII. fig. 13.)

Long. 67–69 μ; lat. sine spin. 69–73 μ, cum spin. 82–86 μ; lat. isthm. 13–14·5 μ.

The American specimens of this variety were one and a half times as large as those from Madagascar!

103. S. glabrum, Ralfs, Brit. Desm. p. 217; Roy, in Journ. Bot. xxviii. (1890) p. 337. (*Desmidium glabrum*, Ehrenb.; *Phycastrum glabrum*, Kuetz. Phycolog. Germ. p. 137.)

Var. (Pl. XVI. fig. 8.)

Long. 21 μ; lat. s. spin. 25 μ, c. spin. 56 μ; long. spin. 17·5 μ; lat. isthm. 8 μ.

The spines were longer than in British specimens; they were strongly inflexed and straight in front view, but somewhat curved in vertical view. *S. dejectum*, Wolle (Desm. U.S. pl. xl. fig. 7), is most probably a form of this species.

104. S. corniculatum, Lund. Desm. Suec. p. 57, t. iii. fig. 23.

Var. variabile, Nordst. Freshw. Alg. of New Zeal. & Austr. p. 39, t. 4. fig. 17.

Long. 29 μ; lat. 28·5 μ; lat. isthm. 11·5 μ.

The form seen had the angles distinctly but very slightly mucronate.

105. S. sibiricum, Borge, in Bihang Sv. Vet.-Akad. Handl. xvii. (1891) Afd. iii. no. 2, p. 9, t. 1. fig. 4.

Var. occidentale, nov. var. (Pl. XVI. fig. 9.) Var. semicellulis apicibus levissime concavis, profundius constrictis; a vertice visis triangularibus, lateribus valde concavis, angulis obtusis (non porrectis).

Long. 12·5–17·5 μ; lat. 19–30 μ; lat. isthm. 5–7 μ.

Hab. Orono, Maine.

This appears to be most nearly related to *S. sibiricum* in its front view, though having a deeper constriction; it is also closely akin to *S. minutissimum*, Reinsch (Algenfl. Franken, p. 153, t. 13. fig. 1; Contrib. Alg. et Fung. t. 16. fig. 3), var. *constrictum*, West (in Journ. Linn. Soc. (Bot.) xxix. (1892) p. 173, pl. 24. fig. 14), but differs in its angles being less rounded and in the more concave sides of the vertical view.

106. STAURASTRUM ARISTIFERUM, Ralfs, Brit. Desm. p. 123, t. 21. fig. 2.

Var. PARALLELUM, nov. var. (Pl. XVI. fig. 10.) Var. semicellulis apicibus convexis sed retusis in medio, angulis subcapitato-truncatis, spinis parallelis et levissime incurvatis; a vertice visis triangularibus, lateribus convexis, angulis productis et truncatis.

Long. 35 μ; lat. s. spin. 31 μ, c. spin. 62–72 μ; lat. isthm. 7·5 μ.

107. ? S. PTEROSPORUM, Lund. Desm. Suec. p. 60, t. 3. fig. 29.

Long. s. spin. 19 μ, c. spin. 27·5 μ; lat. s. spin. 17·5 μ, c. spin. 22 μ; lat. isthm. 7 μ.

Hab. Scarbro', Maine.

A *Staurastrum* was observed exactly agreeing with the above species in vertical view. The front view had the angles very slightly produced, but sufficiently so to make the apex appear very slightly concave; the spines were typical.

108. S. SUBSCOLOPACINUM, nov. sp. (Pl. XVI. fig. 11.) *S.* minutum, tam longum quam latum (sine spinis), profunde constrictum, sinu subsemicirculari, isthmo elongato; semicellulæ latæ cuneatæ, apicibus subrectis, angulis productis subcapitatis, spinâ singulâ brevi incurvatâ ad angulum unumquemque; a vertice visæ triangulares, lateribus subrectis, angulis productis subcapitatis, spinis curvatis instructæ; membrana glabra.

Long. 17·5–18 μ; lat. s. spin. 17·5–19 μ, c. spin. 25–27 μ; lat. isthm. 3·5–3·8 μ.

This differs from *S. scolapacinum*, W. B. Turn. (Freshw. Alg. of E. India, p. 107, t. 17. fig. 10), in its much smaller size, in the almost straight sides of both front and vertical views, in its relatively smaller body, and in its somewhat curved and inflexed spines.

109. S. UNICORNE, W. B. Turn. Freshw. Alg. of E. India, p. 107, t. 15. fig. 16.

Var. OBESUM, nov. var. (Pl. XVI. fig. 12.) Var. angustior, isthmo longiore; semicellulis in capitulis angulorum sine collis et subtruncatis, spinis multo minoribus rectis convergentibus, dorso altiore; a vertice visis obesis, lateribus convexioribus.

Long. 32 μ; lat. s. spin. 25·5 μ; lat. c. spin. 29 μ; lat. isthm. 6 μ.

110. S. BACILLARE, Bréb.; Ralfs, Brit. Desm. p. 214, t. 35. fig. 21.

Long. 20 μ; lat. c. proc. 24 μ; lat. isthm. 6·5 μ.

A tetraradiate form near var. *obesum*, Lund. (Desm. Suec. p. 57, t. 3. fig. 24).

Wolle's figure (Alg. U.S. pl. 57. figs. 5, 6) of this species is certainly a much stouter form than Lundell's var. *obesum*; it is very different from the figure of Brébisson in Ralfs (*l. c.*).

111. S. ABRUPTUM, nov. sp. (Pl. XVI. fig. 13.) *S.* minutissimum, $1\frac{1}{2}$-plo longius quam latius, profunde constrictum; semicellulæ subellipticæ, apicibus subconcavis, angulis leviter productis truncatis; a vertice visæ triangulares, lateribus concavis, angulis truncatis; membrana glabra.

Long. 9·5 μ; lat. 13·5 μ; lat. isthm. 4·5 μ.

Una tantum semicellula a nobis visa est.

112. Staurastrum inconspicuum, Nordst. Bidrag Sydlig. Norges Desm. p. 26, t. 1. fig. 11.

Long. 12·5–16 μ; lat. 11·2–15 μ; lat. isthm. 6–6·5 μ.

We have met with this frequently in N. American gatherings, and, as Wolle's figure is somewhat crude, we give a figure of the front view of a rather broad form (long. 15·5 μ; lat. 17·8 μ; lat. isthm. 5·5 μ). (Pl. V. fig. 14.)

113. S. Hantzschii, Reinsch, Spec. Alg. Fung. p. 129, t. 22 D. figs. 1, 4, 6.

Var. congruum, nobis. (Pl. XVI. fig. 15.) (*S. Renardi*, Reinsch, var. *congruum*, Racib. in Pamiet. Akad. Krak. xvii. (1890) p. 101, t. 3. fig. 11; *S. Hantzschii*, Reinsch, var. *depauperatum*, Gutw. in Sprawozd. Akad. Krak. xxvii. II. (1892) p. 71, t. 3. fig. 23; *S. intricatum*, Delp. (ex part.) Desm. Subalp. t. 11. fig. 15.)

Long. s. proc. 33·5 μ, c. proc. 40 μ; lat. s. proc. 26 μ, c. proc. 36 μ; lat. isthm. 13·5 μ.
Hab. Scarbro', Maine.

Several examples of this were observed; they all had six short, thick processes, with tridenticulate apices in the superior whorl, and nine similar ones in the inferior whorl. The sides in the vertical view were slightly convex. This plant is evidently the one seen by both Raciborski and Gutwinski, and is certainly a form of *S. Hantzschii*, Reinsch, and not of *S. Renardi*, Reinsch; as Raciborski's name is the earlier one, we have adopted it.

114. S. quadricornutum, Roy et Biss. in Journ. Bot. xxiv. (1886) p. 240, t. 268. fig. 4.

Long. c. proc. 27·4–30 μ; lat. c. proc. 25–28 μ; lat. isthm. 8–8·7 μ.

This is not an unfrequent species. Roy and Bisset say that "it is in front view entirely different from any other known species." *S. gemelliparum*, Nordst. (in Vidensk. Meddel. 1869 (1870) p. 230, t. 4. fig. 54), however, is very near it.

One of the specimens seen had the two inferior processes of one angle replaced by a single larger process. (Pl. XVIII. fig. 18.)

115. S. quadrangulare, Bréb. in Ralfs, Brit. Desm. p. 128, tab. 22. fig. 7.

Long. 20 μ; lat. s. spin. 25–30 μ, c. spin. 30–34 μ; lat. isthm. 13·5 μ.

A broad form of this with somewhat longer spines is figured for comparison with the following variety. (Pl. XVI. figs. 16, 17.)

Var. armatum, nov. var. (Pl. XVI. fig. 18.) Var. spinis ad angulos superiores longioribus, iis ad angulos inferiores spinis bifurcatis cum cuspidibus inæqualibus (cuspidibus longioribus prope basin).

Long. 22 μ; lat. s. spin. 25 μ, c. spin. 32·5 μ; lat. isthm. 10·5 μ.

All the specimens seen were triangular in vertical view. Compare with *S. contectum*, W. B. Turn., and var. *inevolutum*, W. B. Turn.

116. S. contectum, W. B. Turn. Freshw. Alg. of E. India, p. 111, t. 15. fig. 20.

Var. inevolutum, W. B. Turn. *l. c.* t. 15. fig. 2, & t. 27. fig. 11. (Pl. XVI. fig. 19.)

Long. 26–27 μ; lat. c. spin. 30·5–32·5 μ; lat. isthm. 7–7·5 μ.

A form of this was noticed which appeared to connect this species with *S. quadrangulare*, Bréb., var. *armatum*, n. var. Perhaps these all belong to one species.

117. STAURASTRUM QUADRISPINATUM, W. B. Turn. in Naturalist (Feb. 1886), p. 35, pl. 1. fig. 4. (Pl. XVIII. fig. 17.)

Long. s. spin. 30–31 μ, c. spin. 43–49 μ; lat. s. spin. 29–30·5 μ, c. spin. 38·5–46 μ; lat. isthm. 10·5 μ.

The examples seen of this species were more strictly angular in both front and vertical views than Turner's figure. The spines in the vertical view were perpendicular to the sides and almost in a line with the broadly truncate angles. The specimens had a punctate membrane. Mr. L. N. Johnson has very recently recorded this species from Indiana (in Bull. Torr. Bot. Club, xxi. (1894) p. 289).

118. S. TRIFIDUM, Nordst. in Vidensk. Meddel. 1869 (1870) p. 226, t. 4. fig. 51. Forma. (Pl. XVI. figs. 20, 21).

Long. 30–32 μ; lat. s. spin. 32–36·5 μ; lat. cum spin. 44–50 μ; lat. isthm. 10–12 μ.

Var. INFLEXUM, nov. var. (Pl. XVI. fig. 22.) Var. semicellulis latioribus, sinu extremum versus angustiori, apicibus subrectis, spinis longioribus valde inflexis et leviter recurvatis; membrana glabra.

Long. 28·5 μ; lat. s. spin. 30·5 μ, c. spin. circ. 44 μ; lat. isthm. 9 μ.

This agrees with var. *glabrum*, Lagerh. (in Öfvers. Sv. Vet.-Akad. Förh. (1885) n. 7, p. 247), in the smooth membrane and longer spines; but as his variety is not described with inflexed spines, the forma *torta* placed by Bœrgesen (in Vidensk. Meddel. 1890 (1891), p. 49, t. 5. fig. 56) under this variety should be var. *inflexum*, forma *torta*.

119. S. SPICATUM, West & G. S. West, in Journ. Bot. xxxiii. (1895) p. 70. [=*S. dubium*, B. Eichl. & Gutw. Nonn. Spec. Alg. Nov. 1894, p. 15, t. 5. figs. 52, 53 (non *S. dubium*, West, in Journ. Roy. Micr. Soc. (1890) p. 295, t. 6. fig. 28).] (Pl. XVI. fig. 23.)

The following is the description of the American specimens, written some time before Eichler and Gutwinski's paper appeared :—

S. parvum, tam longum quam latum (sine spinis), profunde constrictum, sinu aperto et acutangulo; semicellulæ late suboblongæ, lateribus et apicibus leviter concavis, angulis inferioribus spinâ brevi singulâ convergente instructis, angulis superioribus spinis longis suberectis duobus instructis; a vertice visæ triangulares, lateribus levissime retusis, angulis subrotundatis spinâ brevi singulâ et angulos versus utrobique spinâ singulâ instructis; membrana glabra.

Long. s. spin. 21 μ, c. spin. 38·5 μ; lat. s. spin. 21 μ, c. spin. 29 μ; lat. isthm. 7·5 μ.

This species is nearest to *S. quandrangulare*, Bréb., var. *longispina*, Bœrg. in Vidensk. Meddel. 1890 (1891), p. 49, t. 5. fig. 55.

120. S. SUBTRIFURCATUM, nov. sp. (Pl. XVI. fig. 24.) *S.* mediocre, sextâ parte latius quam longius, modice constrictum, sinu aperto acutangulo lateribus concavis; semicellulæ oblongæ, lateribus valde concavis, apicibus leviter convexis, angulis

inferioribus spinâ longâ validâ singulâ convergente instructis, angulis superioribus spinis duabus longis validis subdivergentibus instructis; a vertice visæ triangulares, lateribus concavis, angulis truncato-retusis, spinis longis validis tribus subdivergentibus præditis; membrana glabra.

Long. 30 μ; lat. s. spin. 35 μ, c. spin. 74 μ; lat. isthm. 14·5 μ.

This differs from *S. trifurcatum*, W. B. Turn. (Freshw. Alg. of E. India, p. 110), and var. *reversum*, W. B. Turn. (*l. c.* t. 17. fig. 9), in its relatively longer and straighter spines, in its very different sinus, its shorter length, and its concave sides in vertical view without any constriction below the angles.

S. brasiliense, Nordst., var. *triquetrum*, Wolle (Alg. U.S. p. 46, pl. 60. figs. 39, 40), is probably the same species as this, but his figure is not sufficiently clear to determine the point; it certainly is not a variety of *S. brasiliense*, Nordst.

121. Staurastrum brasiliense, Nordst. in Vidensk. Meddel. 1869 (1870), p. 227, t. 4. fig. 39.

Var. Lundellii, nov. var. (*S. brasiliense*, Nordst. forma; Lund. Desm. Suec. p. 73, t. 5. fig. 2; Cooke, Brit. Desm. pl. 61. fig. 2.) Var. duplo-major (interdum subduplo-major), cellulis quam spinæ paulo longioribus, dorso rectis vel leviter convexis, a vertice visis 5-gonis (rarissime 6-gonis); membrana minute scrobiculata.

The following represents the dimensions of one of the larger forms:—

Long. s. spin. 83 μ, c. spin. 135 μ; lat. s. spin. 80 μ, c. spin. 144 μ; lat. isthm. 35 μ.

The plant which we have seen commonly from N. America, Ireland, and N. Wales is sufficiently different from the Brazilian type to rank as a distinct variety. Two of the three spines at the angles are generally placed horizontally, and the third is inserted above them at an angle. The cavity of this *Staurastrum* is only mamillate within the base of the spines, and does not project almost to the apex as shown by Wolle (Desm. U.S. pl. xlviii. figs. 1–3). The figure by the latter of the front view is erroneous.

Cooke's figures of both front and vertical views are very bad representations of British examples; his front views also show but two spines at each angle instead of three.

122. S. claviferum, nov. sp. (Pl. XVI. fig. 25.) *S.* mediocre, paulo longius quam latius, profunde constrictum, sinu aperto acutangulo; semicellulæ subellipticæ, dorso quam ventre convexiores, spinis brevibus validis numerosis in lineis subregulariter ordinatis instructæ, ad angulos cum spinis tribus (fere) longioribus, sine spinis in sinu, apicibus subglabris; a vertice visæ triangulares, lateribus retusis, angulis subrotundatis, cum spinis brevibus subirregulariter ordinatis, ad angulos longioribus; glabræ in centro.

Long. s. spin. 38–40 μ; lat. s. spin 36–38 μ, c. spin. 42–44 μ; lat. isthm. 10·5–12·5 μ.

At first we considered the species to be *S. Ravenelii*, Wood, 1873 (Wolle, Desm. U.S. p. 143, pl. 52. figs. 7, 8 [=*S. sparsiaculeatum*, Schmidle, 1895]), to which it is very closely related. After examining a number of specimens, however, and finding constant differences between them and the figure of Wolle, we thought it better to define what we have seen as distinct.

123. Staurastrum Brebissonii, Arch. in Pritch. Infus. ed. IV. p. 739.

Var. heteracanthum, nov. var. (Pl. XVI. fig. 26.) Minus, semicellulis spinis ad angulum unumquemque paucioribus, cum spinis tribus validioribus quam spinæ reliquæ; a vertice visæ lateribus subrectis.

Long. 35 μ; lat. sine spin. 35 μ, cum spin. 50 μ; lat. isthm. 11·5 μ.

124. S. setigerum, Cleve, in Öfvers. Sv. Vet.-Akad. Förh. 1863 (1864), n. 10, p. 490, t. iv. fig. 4; Lund. Desm. Suec. t. iv. fig. 3; Roy et Biss. in Ann. Scot. Nat. Hist. (1893) p. 243, pl. 3. fig. 9. (*S. Royanum*, Arch. in Quart. Journ. Micr. Sc. xvii. (1877) p. 103; Cooke, Brit. Desm. p. 152.)

Var. occidentale, nov. var. (Pl. XVI. fig. 7.) Var. semicellulis depressis, anguste ellipticis, spinis ad angulos ut in formâ typicâ, reliquis longioribus, paucioribus, et irregulariter dispositis; a vertice visis lateribus concavis, angulis rotundioribus.

Long. s. spin. 31 μ; lat. s. acul. 38 μ, c. acul. 67 μ; lat. isthm. 10 μ.

This variety differs much from the type in being broader than long, in the fewer scattered spines, and in the concave sides of the vertical view.

Var. pectinatum, nov. var. (Pl. XVI. fig. 28.) [=*S. setigerum*, Wolle, Desm. U.S. p. 141, pl. 45. figs. 26, 27.] Var. minor, semicellulis spinis intra angulos validioribus et longioribus (subcurvatis); sinu minus aperto.

Long. s. spin. 34 μ, cum spin. 44 μ; lat. s. spin. 31 μ, cum spin. 46 μ; lat. isthm. 6·5 μ.

Hab. Harvey Lake, Lycoming Co., Pa.

125. S. minnesotense, Wolle, Freshw. Alg. of U.S. p. 43, pl. 57. figs. 7, 8. (Pl. XVII. fig. 15.)

Long. s. spin. 84–86 μ, cum spin. 117–128 μ; lat. s. spin. 71–78 μ, cum spin. 105–125 μ; lat. isthm. 23–28 μ.

The two spines at the angles are always stronger than the rest, and the latter are generally somewhat irregular both in length and disposition. The only regular specimen seen had nine pairs of spines to each semicell (fig. 15, *b*). In vertical view the sides are slightly convex and retuse towards the middle; the angles are not anything like so acute as figured by Wolle.

126. S. maamense, Arch. in Quart. Journ. Micr. Sc. ix. (1869) p. 200. (*S. pseudocrenatum*, Lund. Desm. Suec. p. 65, t. 4. fig. 4.)

The figure given by Wolle (Alg. U.S. pl. 57. fig. 10) of the front view of this species is erroneous; the drawing must have been made from a much tilted specimen, for the warts would not otherwise show at the apices. All the American specimens we have seen are similar to the European ones.

127. S. subscabrum, Nordst. Alg. Aq. dulc. et Char. insul. Sandvic. p. 16, t. 2. fig. 2. Long. 27 μ; lat. 26 μ; lat. isthm. 7·5 μ. (Pl. XVIII. fig. 12.)

128. S. trihedrale, Wolle, Desm. U.S. p. 123, pl. 40. figs. 12, 13. (Pl. XVI. fig. 29.)

We have found some examples which must belong to this species, the form of the cells

agreeing well with his figure except in the sinus; the sinus of our examples was narrow as in his description. As his description is too meagre and not quite correct, and also as his figure and description do not agree, we give both.

S. submediocre, $1\frac{1}{2}$-plo longius quam latius, profunde constrictum, sinu angusto-lineari extremo leviter ampliato; semicellulæ triangulares, angulis inferioribus rotundatis et subtruncatis, lateribus inferioribus inflatis, lateribus superioribus concavis, apicibus subtruncato-rotundis; a vertice visæ triangulares, lateribus concavis, angulis rotundatis; membrana scrobiculata.

Long. 42–43 μ; lat. 28–29 μ; lat. apic. 8·5–9·5 μ; lat. isthm. 9–10 μ.

The membrane is finely scrobiculate, and not "punctate granulate" as stated by Wolle.

Var. RHOMBOIDEUM, nov. var. (Pl. XVI. fig. 30.) Var. semicellulis longioribus, lateribus superioribus subrectis, apicibus truncatis et levissime retusis; a vertice visis triangularibus, lateribus rectis.

Long. 52 μ; lat. 27·5 μ; lat. apic. 9·5 μ; lat. isthm. 11·5 μ.

129. STAURASTRUM INSIGNE, Lund. Desm. Suec. p. 58, t. 3. fig. 25.

Long. 21 μ; lat. 14 μ; lat. isthm. 5 μ.

A smaller and comparatively longer form of this characteristic species was observed.

130. S. LANCEOLATUM, Arch. in Quart. Journ. Micr. Sc. ii. (1862) p. 248, t. 12. figs. 16–22.

Var. COMPRESSUM, West, New Brit. Alg., in Journ. Roy. Micr. Soc. (1894) p. 11, pl. 1. fig. 22.

Long. 17·5 μ; lat. 21·2 μ; lat. isthm. 7·5 μ.

131. S. AVERSUM, Lund. Desm. Suec. p. 59, t. 3. fig. 27.

Long. 36 μ; lat. 33 μ; lat. isthm. 16·5 μ.

Hab. Orono, Maine.

132. S. GRANDE, Bulnh. in Hedwigia, vol. ii. (1863) t. 9. fig. 14.

Var. ROTUNDATUM, nov. var. (Pl. XVI. fig. 31.) Var. robustum, sinu acutissimo minus aperto, semicellulis inflatis, angulis rotundioribus, dorso convexiore.

Long. 81–86 μ; lat. 67–70 μ; lat. isthm. 20–23 μ.

A rather frequent variety.

133. S. BOTROPHILUM, Wolle, Desm. U.S. p. 131, pl. 42. figs. 11–13.

Long. 47 μ; lat. 38–40·5 μ; lat. isthm. 9 μ.

The examples seen of this had the apices more abruptly truncate than Wolle's figure; the vertical view had slightly retuse sides and less rounded angles. The sinus was narrowly linear. Fig. 13 (Wolle, *l. c.*) is certainly an incorrect drawing, for it is impossible to get such a wide open sinus from a linear one in any position (*vide* fig. 11, Wolle, *l. c.*). This approaches *S. Arnellii*, Boldt, in Öfvers. Sv. Vet.-Akad. Forh. 1885 (1886), n. 2, p. 112, t. 5. fig. 21, in form, but has a much narrower isthmus and differently arranged granules.

134. STAURASTRUM BRACHIATUM, Ralfs, Brit. Desm. p. 131, t. 23. fig. 9.

Long. 36·5–55 μ; lat. 36·5–57·5 μ; lat. isthm. 9·5–14 μ; diam. zygosp. cum proc. 32–42 μ.

Several zygospores of this were seen from Orono, Maine. *Cfr.* West, in Journ. Bot. xxv. (1889) p. 205. (Pl. XVI. fig. 32.)

135. S. ARCUATUM, Nordst. Bidrag Sydlig. Norges Desm. p. 36, fig. 18.

Forma ACICULIFERA. (Pl. XVI. fig. 34.) Forma processibus longioribus et horizontaliter dispositis, processibus dorsalibus ad apices leviter dilatatis, spinis inæqualibus, una multo longiore.

Long. c. spin. 27 μ, s. spin. 19 μ; lat. (c. spin.) 48·5 μ; lat. isthm. 9·5 μ.

The *S. arcuatum* figured by Wolle (Desm. U.S. pl. 46. figs. 13, 14) is certainly not *S. arcuatum*, Nordst.

136. S. SEXVERRUCOSUM, nov. sp. (Pl. XVI. fig. 35.) *S.* subparvum, paulo latius quam longius (sine spinis) profunde constrictum, sinu acuto aperto; semicellulæ anguste ellipticæ, angulis bispinatis seriebus tribus granulorum transverse ornatæ, dorso verrucis tridenticulatis præditæ; a vertice visæ triangulares lateribus concavis, angulis obtusis spinatis, seriebus tribus granulorum transverse dispositis, in centro cum annulo verrucarum tridenticulatarum 6.

Long. 25 μ; lat. 34·5 μ; lat. isthm. 6 μ.

The nearest species to this is *S. arcuatum*, Nordst., from which it differs in its thicker and less produced angles, in the dorsal verrucæ, &c.

137. S. VALIDUM, nov. sp. (Pl. XVI. fig. 36.) *S.* parvum, 1⅓-plo latius quam longius, profunde constrictum, sinu aperto ad extremum subacuto; semicellulæ elliptico-lunatæ, marginibus inferioribus leviter biundulatis, apicibus glabris, marginibus superioribus verrucis emarginatis ornatis, angulis tridenticulatis; a vertice visæ triangulares lateribus concavis et angulos versus leviter undulatis, angulis productis truncatis et tridenticulatis, intra marginem lateralem unumquemque verrucis emarginatis 4 ornatæ, verrucis duabus prope apicem anguli uniuscujusque; in centro glabræ.

Long. 27–29 μ; lat. 36–38 μ; lat. isthm. 7–7·5 μ.

138. S. DELICATISSIMUM, nov. sp. (Pl. XVI. fig. 37.) *S.* parvum, paulo longius quam latius, modice constrictum; semicellulæ obtriangulares, lateribus superioribus minutissime biundulatis, apicibus subrectis, angulis processibus delicatissimis longis glabris productis, apicibus leviter dilatatis et subtruncatis; a vertice visæ triangulares, lateribus subrectis, spinis minutissimis duabus instructis, angulis in processus delicatissimos glabros productis.

Long. s. proc. 11·5 μ, c. proc. 34 μ; lat. s. proc. 9·5 μ, c. proc. 30 μ; lat. isthm. 4 μ.

The minute spines on each side of the vertical view show best when the plant is seen obliquely.

139. Staurastrum parvulum, nov. sp. (Pl. XVII. fig. 1.) *S.* minutum, pæne 1½-plo longius quam latius (sine processibus), modice constrictum, sinu aperto; semicellulæ rectangulares, lateribus apicibusque leviter concavis, angulis superioribus in processus longos arcuatos tenues minute nodulosos productis, apicibus minutissime tridenticulatis, cum spina singula minuta ad angulum basalem sub processu unoquoque; a vertice visæ triangulares, lateribus subrectis, angulis in processus longos hypocyrtocerosos productis, denticulo minutissimo ad basin processus uniuscujusque utrobique.

Long. 11·5 μ; lat. sine proc. 8 μ, cum proc. 25–26·5 μ; lat. isthm. 4·5 μ.

This little species does not appear to be very closely related to any other. The small spines at the basal angles and directly under each process are best seen when the plant is somewhat tilted.

140. S. genuflexum, nov. sp. (Pl. XVII. fig. 2.) *S.* parvum, paulo longius quam latius (sine processibus), ad medium modice constrictum; semicellulæ cyathiformes, apicibus subrectis, angulis superioribus productis divergentibus subito genuflexis in processus longos tenues attenuatos convergentes undulatos productis, apicibus subobtusis; a vertice visæ triangulares, lateribus rectis, angulis in processus longos subcurvatos undulatos productis; membrana glabra.

Long. 13·5 μ; lat. sine proc. 11 μ; lat. cum proc. 40 μ; lat. isthm. 5 μ.

141. S. subgracillimum, nov. sp. (Pl. XVII. figs. 3, 4.) *S.* parvum, circiter tam longum quam latum (sine processibus); semicellulæ late cuneatæ, lateribus rectis, apicibus retusis, angulis superioribus in processus longos horizontales non attenuatos minutissime undulatos productis; a vertice visæ triangulares lateribus levissime concavis, angulis in processus longos productis, apicibus processuum a dentibus subpatentibus incurvatis tribus instructis; processibus unius semicellulæ cum iis alterius alternantibus; membrana glabra.

Long. 10·5–11·5 μ; lat. s. proc. 10–11 μ, c. proc. 54–60 μ; lat. isthm. 4·8–5·5 μ.

On seeing but two specimens of this we placed it as a variety of *S. gracillimum*, West & G. S. West (in Trans. Linn. Soc. ser. II., Bot. v. (1895) p. 75, pl. 8. fig. 31), but after seeing many more examples, and finding its characters constant, we thought it advisable to regard it as a distinct species. The processes are of a different nature from those of *S. gracillimum*; they are less attenuated, very minutely nodulate, and the apices are not deeply bifurcate, but furnished with three spreading incurved teeth. In the front view the processes are almost horizontal and the teeth at their apices are seen to be in one plane, the apex of the semicell is concave, and in vertical view the sides are very slightly concave or almost straight.

142. S. Asteroideum, nov. sp. (Pl. XVII. fig. 5.) *S.* parvum, paulo latius quam longius (cum processibus), modice constrictum; semicellulæ quadrato-cuneatæ, apicibus convexo-truncatis, angulis superioribus in processus bi- vel trinodulosos leviter curvatos extrorsum productis, apicibus tridenticulatis; a vertice visæ 5-radiatæ, processibus tam longis quam diameter corporis; membrana glabra.

Long. s. proc. 15–16·5 μ, c. proc. 19–24 μ; lat. s. proc. 8·5–10·5 μ, c. proc. 25–27 μ; lat. isthm. 5·5 μ.

The nearest species to this is *S. franconicum*, Reinsch (Algenfl. Franken, p. 158, t. 12. fig. 3), from which it differs considerably. A good many examples of this were seen, all of which were 5-rayed. Compare also with *S. zonatum*, Bœrg. (in Vidensk. Meddel. 1890 (1891), p. 46, t. 5. fig. 48).

143. Staurastrum bicoronatum, N. L. Johnson, in Bull. Torr. Bot. Club, xxi. (1894) p. 290, pl. 211. fig. 9.

Var. simplicius, nov. var. (Pl. XVII. fig. 6.). Var. semicellulis a vertice visis sine annulo spinarum parvarum furcatarum intra marginem; apicibus processuum emarginatis et bidenticulatis (non trifidis); processibus unius semicellulæ cum iis alterius alternantibus.

Long. 14·5 μ; lat. s. proc. circ. 9·5 μ, c. proc. 32–34·5 μ; lat. isthm. 6 μ.

We had this variety described as a species in manuscript some time before Johnson's paper appeared; it differs from his sufficiently to make a well-marked variety.

144. S. incisum, Wolle, Desm. U.S. p. 132, pl. 41. figs. 12–14.

Var. effiguratum, nov. var. (Pl. XVII. fig. 7.) Var. semicellulis a vertice visis incisurâ inter processus apertiore, processibus ornatis cum processu brevi prope basin utrobique.

Long. 25 μ; lat. c. proc. 42 μ; lat. isthm. 9 μ.

Compare with *S. ornatum*, W. B. Turn. (Freshw. Alg. of E. India, p. 115, t. 13. fig. 28*; *S. margaritaceum*, Ehrenb., f. *ornata*, Boldt, in Öfvers. Sv. Vet.-Akad. Förh. 1885 (1886), n. 2, p. 115, t. 5. fig. 27).

145. S. logimum, nov. sp. (Pl. XVII. fig. 8.) *S.* mediocre, duplo longius quam latius (sine processibus), modice constrictum; semicellulæ subquadrangulares, lateribus bicrenatis crenâ inferiore majore et subemarginatâ, apicibus levissime concavis, angulis superioribus in processus longos tenues leviter divergentes et subflexuosos productis, subnodulosis basin versus et subundulatis apicem versus, apicibus cum dentibus quattuor divergentibus sed incurvatis; a vertice visæ triangulares lateribus subrectis, angulis in processus longos productis; cum basi semicellularum trigonâ lateribus concavis et angulis truncato-emarginatis; membrana glabra.

Long. s. proc. 25–27 μ; lat. s. proc. 13–14 μ, c. proc. 75–80 μ; lat. isthm. 7·7 μ.

This seems a characteristic species, of which only three examples have been seen.

146. S. paradoxum, Meyen; Ralfs, Brit. Desm. p. 138, t. 23. fig. 8.

Var. osceolense, Wolle, Alg. U.S. p. 45, pl. 59. figs. 8, 9. Forma *minor*. (Pl. XVII. fig. 9.) Forma semicellulis a vertice visis triangulares.

Long. s. proc. 15 μ, c. proc. 31 μ; lat. s. proc. 9·5 μ, c. proc. 42 μ; lat. isthm. 4·5 μ.

Fig. 8, pl. 59 (Wolle), does not represent a front view; it is much tilted and incorrectly drawn.

147. STAURASTRUM ASPINOSUM, Wolle, Desm. U.S. p. 143, pl. 51. figs. 22, 23.

Var. ANNULOSUM, nov. var. (Pl. XVII. fig. 10.) Var. spinis brevibus multis circa basin processuum, processibus undulato-denticulatis, cum annulo spinarum majorum parti tertiæ longitudinis processus uniuscujusque de apice.

Long. s. proc. 17 μ, c. proc. 46 μ; lat. s. proc. circ. 17 μ, c. proc. 52 μ; lat. isthm. 5·8 μ.

We have only seen one example of this variety.

148. S. BARBATUM, nov. sp. (Pl. XVII. fig. 11.) *S.* parvum, 1⅓-plo longius quam latius (sine processibus), modice constrictum; semicellulæ obsemicirculares, dente parvo utrobique basin versus constrictionis, apicibus subconvexis, angulis in processus longos acute trinodulosos productis, apicibus subcapitatis cum spinis brevibus divergentibus armatis; a vertice visæ triangulares, lateribus levissime concavis, angulis in processus longos acute 1-nodulosos productis.

Long. s. proc. 16 μ, c. proc. 38·5 μ; lat. s. proc. 12 μ, c. proc. 38–40 μ; lat. isthm. 5 μ.

This differs from *S. aspinosum*, Wolle, in its smaller size and shorter arms, which are regularly 3–4-nodulose and not furnished with irregular perpendicular spines; the apices of the processes are also very different.

149. S. BRACHIOPROMINENS, Bœrg. in Vidensk. Meddel. 1890 (1891), p. 47, t. 5. fig. 52.

Long. s. proc. 29 μ, c. proc. 46 μ; lat. s. proc. 19 μ, c. proc. 60 μ; lat. isthm. 10·5 μ; crass. 12 μ.

As Bœrgesen states that he was somewhat uncertain as to the vertical view, we give a figure. (Pl. XVII. fig. 12.)

Var. ROBUSTUM, nov. var. (Pl. XVII. fig. 13.) Var. processibus minus divergentibus et validioribus, verrucis ad apices majoribus, etiam cum verrucis longis minoribus emarginatis prope basin marginis superioris; membrana non ornata.

Long. 27–30 μ; lat. c. proc. 54·5–60 μ; lat. isthm. 6–7 μ.

150. S. NATATOR, West, in Journ. Linn. Soc. (Bot.) xxix. (1892) p. 183, pl. 23. fig. 14.

Var. CRASSUM, nov. var. (Pl. XVII. fig. 4.) Var. semicellulis projectione centrali multo majore, annulo granulorum (circ. 12), granulis tribus intra annulum; verrucis ad apicem truncato-denticulatis.

Long. s. proc. 31–36 μ, c. proc. 41–48 μ; lat. s. proc. circ. 19 μ, c. proc. 65–69 μ; lat. isthm. 7·5–9·5 μ; crass. 25 μ.

The vertical and lateral views of this species remind one of *S. minneapoliense*, Wolle, but the front view at once precludes this idea.

151. S. GRALLATORIUM, Nordst. in Vidensk. Meddel. 1869 (1870), p. 228, t. 4. fig. 52.

Var. AMERICANUM, nov. var. (Pl. XVII. fig. 15.) Var. cellulis profundius constrictis, semicellulis latioribus quam in formâ typicâ (obverse semicircularibus), apicibus truncato-convexis et glabris, processibus divergentibus sed incurvatis.

Long. s. proc. 29–31 μ; lat. s. proc. 21–23 μ, c. proc. 73–75 μ; lat. isthm. 6·5–7·5 μ; crass. 16 μ.

152. Staurastrum leptocladum, Nordst. in Vidensk. Meddel. 1869 (1870), p. 228, t. 4. fig. 57.

Var. insigne, nov. var. (Pl. XVII. fig. 17.) Var. semicellulis paulo brevioribus, processibus extrorsum et valde curvatis, apicibus verrucis emarginatis quattuor ornatis; a vertice visis projectione medianâ subemarginatâ utrobique instructis.

Long. s. proc. 35 μ, c. proc. 76 μ; lat. s. proc. circ. 17 μ, c. proc. 85 μ; lat. isthm. 8.5 μ; crass. 16·5 μ.

153. S. Johnsonii, nov. sp. (Pl. XVII. fig. 16.) [= *S. leptocladum*, N. L. Johnson, in Bull. Torr. Bot. Club, xxi. (1894) p. 288, pl. 211. fig. 2.] *S.* mediocre, circiter duplo latius quam longius (cum processibus), modice constrictum; semicellulæ subcampanulatæ, ad basin truncato-inflatæ cum annulis duobus granulorum (annulo superiore plerumque irregulari), apicibus verrucis denticulato-truncatis 5–7 ornatis et verrucis 5–7 intra marginem apicis, angulis superioribus in processus longos subattenuatos leviter divergentes productis, margine superiore acute dentato, margine inferiore subundulato cum denticulis 4 prope basin, apicibus processuum tridentatis; a vertice visæ ellipticæ, verrucis denticulato-truncatis utrobique et serie verrucarum similium intra marginem unumquemque, polis in processus longos denticulatos productis; membrana delicatissima, sed sparsim punctata.

Long. 38·5–44 μ; lat. c. proc. 82·5–88·5 μ; lat. isthm. 9·5–10 μ.

This is a fairly constant species, and differs from *S. leptocladum*, Nordst., in the four rows of denticulate verrucæ at each apex, in the upper side of each process being much rougher than the lower, except for the three to four minute teeth on the under side near the base, as well as in the different base of the semicells. The processes are relatively shorter and stouter, and do not possess that graceful curve—first converging and then diverging—so characteristic of *S. leptocladum*, but are slightly divergent; moreover, no specimen of the latter has ever more than two teeth at the apices of the processes, whereas *S. Johnsonii* has always three.

1 4. S. Anchora, nov. sp. (Pl. XVII. figs.21, 22.) *S.* magnum, duplo latius quam longius (cum processibus), modice constrictum; semicellulæ campanulatæ et leviter inflatæ prope basin, apicibus truncatis et glabris, angulis in processus longos undulato-denticulatos leviter incurvatis productis, apicibus processuum tridentatis, verrucis emarginatis 8 intra apicem unumquemque; a vertice visæ ellipticæ, polis in processus longos undulato-denticulatos productis, verrucis emarginatis 8 intra marginem utrobique.

Long. 65–69 μ; lat. c. proc. 119–136 μ; lat. isthm. 12·5–15 μ.

155. S. ornithopodum, nov. sp. (Pl. XVII. figs. 18–20.) *S.* submagnum, profunde constrictum, sinu extrorsum valde ampliato; semicellulæ subellipticæ vel obsemicirculares, apicibus convexis spinis bi- vel trifurcatis præditis, angulis in processus breves crassos productis, annulo singulo (interdum annulis duobus) denticulorum ornatis, apicibus processuum profunde trifurcatis, dentibus magnis divergentibus;

cum annulo granulorum (circ. 8) ad basin semicellularum; a vertice visæ quadrangulares, lateribus concavis, spinis binis bi- vel trifurcatis ornatis, angulis in processus breves profunde trifurcatos productis, denticulis perpaucis prope basin.

Long. 40–50 μ; lat. s. proc. circ. 35–38 μ, c. proc. 61–82 μ; lat. isthm. 11·5–13·5 μ.

This at first sight reminds one of *S. vestitum*, Ralfs, but after examining many specimens, and the characters being found to be quite constant, it cannot be placed under that species, differing from it in its much shorter and almost smooth processes with stoutly trifurcate apices, and in many other characters. This species is constantly quadrangular.

156. Staurastrum longiradiatum, nov. sp. (Pl. XVII. fig. 23.) *S.* mediocre, 2½-plo latius quam longius (cum processibus), modice constrictum; semicellulæ campanulatæ, angulis inferioribus subrotundatis, apicibus truncatis et verrucis emarginatis ornatis, angulis superioribus in processus longos horizontales (vel subdivergentes) et acute nodulosos productis, apicibus processuum bifurcatis; a vertice visæ triangulares, corpore parvo, lateribus concavis glabris, angulis in processus longos undulatos productis, intra marginem lateralem unumquemque cum serie verrucarum emarginatarum 4; basi semicellularum trigonâ.

Long. 25–30 μ; lat. c. proc. 67–77 μ; lat. isthm. 6–7·5 μ.

The nearest species to this is *S. Pseudosebaldi*, Wille (in Christ. Forh. Vidensk. Selsk. 1880 (1881), p. 45, t. 2. fig. 30).

Forma major. Forma major, apicibus processuum trifurcatis.

Lat. 119 μ.

157. S. floriferum, nov. sp. (Pl. XVIII. fig. 1.) *S.* mediocre, paulo longius quam latius (sine processibus), profunde constrictum; semicellulæ obverse semicirculares, apicibus rectis verrucosis, angulis in processus horizontales longos productis, apicibus processuum tridentatis; processus nodis dentatis binis, dentibus dorsalibus multo longioribus, ad basin processuum, verrucâ emarginatâ ad latus dorsale et dente ad latus ventrale; a vertice visæ triangulares, lateribus subrectis, angulorum processibus binodulosis productis ad basin dilatatis, intra dilatationes verrucis emarginatis duabus, in centro cum annulo verrucarum tridenticulatarum 6 (duæ intra marginem lateralem unumquemque).

Long. 23–25 μ; lat. s. proc. 19–21 μ, cum. proc. 53–55 μ; lat. isthm. 6·5–7·5 μ.

158. S. Sebaldi, Reinsch, Algenfl. Franken, p. 175, t. 11. fig. 1.

As this species is very variable, vertical views of two common forms are given.

Lat. 63–69 μ. (Pl. XVIII. figs. 2, 3.)

Var. altum, nobis. [= *S. proboscideum*, Arch., var. *altum*, Boldt, in Öfvers. Sv. Vet.-Akad. Förh. 1885 (1886), n. 2, p. 117, t. 6. fig. 34.]

Long. 80 μ; lat. c. proc. 70 μ; lat. isthm. 20 μ.

This is too large for *S. proboscideum*, and the ornamentation is much nearer that of *S. Sebaldi*; it is a common American variety.

159. STAURASTRUM CERASTES, Lund. Desm. Suec. p. 69, t. 4. fig. 6. (Pl. XVIII. fig. 4.)

Long. 50–53 μ; lat. c. proc. 57·5–61·5 μ; lat. isthm. 10–12·5 μ.

All the American specimens of this species that we have seen agree exactly with the original Swedish and also with British specimens. The figure given by Wolle (Desm. U.S. pl. 43. figs. 6, 7)—which he states to be "a smoother specimen"—certainly does not represent this species. In all the hundreds of examples of *S. Cerastes* that we have examined, we have never found any but the slightest variations, the general characters, such as the arrangement of the emarginate verrucæ, the smoother under side of the processes, and the elegant curvature of the semicells, remaining quite constant, the "margins and areas" not being "variously roughened." We give a figure of a typical American specimen.

160. S. ZYGÆNA, nov. sp. (Pl. XVIII. fig. 5.) *S.* parvum, tam longum quam latum (cum processibus); semicellulæ longitudinaliter rectangulares, lateribus leviter concavis glabris, angulis inferioribus leviter rotundatis, apicibus convexis, angulis superioribus in processus validos subincurvatos productis, processibus et apicibus denticulatis, apicibus processuum subcapitatis cum annulo spinarum parvarum ad extremum, annulis duobus granulorum minutorum ad basin semicellularum; a vertice visæ triangulares, lateribus denticulatis valde concavis, angulis in processus breves subcapitatos denticulatos productis.

Long. 34 μ; lat. c. proc. 35 μ; lat. isthm. 7 μ.

161. S. ROTULA, Nordst. in Vidensk. Meddel. 1869 (1870), p. 227, t. 4. fig. 38. (Pl. XVIII. fig. 11.)

Long. c. papill. 46·5 μ; lat. c. proc. 58–80 μ.

The North American forms vary considerably in size; the processes are somewhat convergent, and the back of the semicells is not so high as in the Brazilian form (*cfr.* Nordst., Freshw. Alg. of N. Zeal. & Austr. p. 37). Dr. Nordstedt also states that, "to judge by a drawing of living specimens by Mr. C. Löfgren the crenation in the margin should have been sharper (the minute spines would probably have been broken off)." In the specimens we examined the processes were generally trinodulose, but some examples were seen in which the processes had two rings of minute teeth pointing forward. Most of the specimens were 8-radiate in vertical view, but one example seen was 10-radiate, and had 10 apical papillæ, one above the base of each process. Wolle's fig. 14, pl. 44 (Desm. U.S.), does not represent the front view; it is somewhat tilted, and the apical papillæ are not rectangular as he figures them, but obtusely conical: the apices of the processes are not bifid as figured by him; this remark also applies to several other figures of his, such as *S. Ophiura.*

162. S. OPHIURA, Lund. Desm. Suec. p. 69, t. 4. fig. 7.

U.S. specimens of this are very variable both in dimensions and number of rays, the latter varying from 4 to 8. The variety *tetracerum*, Wolle (long. 60 μ, lat. c. proc. 102–132 μ, lat. isthm. 11·5 μ), as we have observed it, has longer and more slender processes than figured by Wolle. (Pl. XVIII. fig. 16.)

163. STAURASTRUM ARCTISCON, Lund. Desm. Suec. p. 70, t. 4. fig. 8. (*Xanthidium Arctiscon*, Ehrenb.)

All the American examples we have seen of this species have shorter processes than the European ones, and they have at most but three rings of small teeth on each process.

Var. GLABRUM, nov. var. (Pl. XVIII. fig. 14.) Var. processibus brevioribus et glabris plerumque levissime bi- (vel tri-) undulatis, apicibus processuum sæpe dentibus majoribus.

Long. s. proc. 63 μ, c. proc. 121 μ; lat. s. proc. 46 μ, c. proc. 101–111 μ; lat. isthm. 21 μ.

164. S. LEPTACANTHUM, Nordst. in Vidensk. Meddel. 1869 (1870), p. 229, t. 4. fig. 46.

Var. DODECACANTHUM, nov. var. (Pl. XVIII. fig. 6.) Var. semicellulis processibus 6 serie inferiore et processibus 6 serie superiore, totis brevioribus quam in forma typica.

Long. c. proc. 81 μ, s. proc. 38·5 μ; lat. c. proc. 71–73 μ, s. proc. 28–29 μ; lat. isthm. 13·5 μ.

This variety has 6 processes in both the upper and lower series, and thus differs from both the type and var. *tetroctocerum*, Wolle (Desm. U.S. p. 151, pl. 51. figs. 29, 30). The vertical view is more triangular than hexagonal.

165. S. WOLLEANUM, Butler, ex Wolle, Alg. U.S. p. 44, pl. 57. figs. 1, 2.

Var. KISSIMENSE, Wolle (*l. c.* pl. 59. figs. 1–3). (Pl. XVIII. fig. 9.)

Long. c. proc. 113 μ, s. proc. 65 μ; lat. c. proc. 110 μ, s. proc. circ. 48 μ; lat. isthm. 30 μ.

This variety has two distinct whorls of six processes. Fig. 1, Wolle (*l. c.* pl. 59), is not a perfect front view; if this species is "regular hexagonal," what does Wolle's fig. 2 represent?

Var. INTERMEDIUM, nov. var. (Pl. XVIII. fig. 8.) Var. semicellulis processibus longioribus ad basin latioribus, attenuatis, et ad apices distincte emarginatis.

Long. c. proc. 90 μ, s. proc. 58 μ; lat. c. proc. 92 μ, s. proc. 40 μ; lat. isthm. 28 μ.

This is intermediate between the type and var. *kissimense*, Wolle, with regard to the length of the processes, though the apices are similar to those of the type but more attenuated.

[Several years before this *species* was published, we had this *variety* drawn and described as *S. digitatum*.]

166. S. XIPHIDIOPHORUM, Wolle, Alg. U.S. p. 44, pl. 57. figs. 21, 22.

Var. BRACHYACANTHUM, nov. var. (Pl. XVIII. fig. 7.) Var. semicellulis altioribus, spinis brevioribus leviter divergentibus 6, angulis inferioribus nonnunquam spinis brevibus convergentibus instructis; a vertice visis subtrigonalibus lateribus subrectis, angulis subrotundatis verruca obtusa et verruca singula utrobique prope angulos instructis.

Long. cum spin. 46–48 μ; long. s. spin. 27–28 μ; lat. 25–30 μ; lat. isthm. 12–12·5 μ.

This is distinguished from the type and var. *simplex*, Wolle (*l. c.* pl. 60. fig. 19), by its much shorter spines, which are also divergent. The sinus is more open than is indicated by Wolle's figures. This *Staurastrum* is triangular, and at each angle there

are three warts (transversely disposed): the outer ones are truncate or subemarginate, and are each situated under a spine, there being two spines at each angle; the central one, which is also situated under a spine in the typical form, is deeply emarginate in a vertical direction, and the lower portion of it sometimes bears a short downwardly-directed spine. Thus, when seen in vertical view, each angle is furnished with three subtruncate "prominences." This is so in the typical form and in var. *brachyacanthum* also, but Wolle says that v. *simplex* has but two of these. This is certainly remarkable, seeing that these two varieties have the same number of spines. The "one-sided, hastate, poignard-like spines" are due to the spines being set on rather to the inner side of short ascending processes of the *Staurastrum*.

167. Staurastrum verrucosum, nov. sp. (Pl. XVIII. fig. 10.) *S.* submediocre, paulo longius quam latius, modice constrictum, sinu parvo subacuto; semicellulæ obtrapeziformes, angulis inferioribus inflatis et annulis denticulorum parvorum (circiter 8 in ambitu), lateribus nodulis acutis (interdum subobtusis) tribus, angulis superioribus subtruncatis, apicibus verrucis magnis emarginato-truncatis 4 obsessis, intra angulos superiores granulis subirregulariter dispositis; a vertice visæ triangulares, lateribus concavis et undulato-denticulatis, angulis truncatis, verrucis binis in seriebus tribus transverse dispositis intra angulum unumquemque, medium versus cellulæ majoribus.

Long. 35 μ; lat. 29 μ; lat. isthm. 9·5 μ.

Genus Dichotomum, nov. gen.

Cellulæ modice constrictæ, semicellulæ bilobæ, lobis dichotomis; a vertice visæ anguste fusiformes.

168. D. elegans, nov. sp. (Pl. XVI. fig. 33.) *D.* mediocre, paulo longius quam latius, modice constrictum; semicellulæ bilobæ apicibus concavis, lobis dichotomis brachiis duobus divergentibus glabris et attenuatis, apicibus profunde bifurcatis; a vertice visæ fusiformes, polis productis; a latere visæ ovato-lanceolatæ; membrana glabra tenuissima.

Long. s. proc. 15 μ, c. proc. 42 μ; lat. s. proc. circ. 12 μ, c. proc. 42 μ; lat. isthm. 6·5 μ; crass. 7 μ.

This genus includes but two species, the above and *D. bibrachiatum*, nobis [=*Staurastrum bibrachiatum*, Reinsch, Contrib. Alg. et Fung. t. xvi. fig. 2], with its var. *cymatium*, West & G. S. West, in Trans. Linn. Soc. ser. II., Bot. v. (1895) p. 74, pl. 8. fig. 28.

About half the Desmids mentioned in this paper are hitherto unrecorded for North America, many of them being new species; of those that remain, either unrecorded varieties of them are noticed, or attention is called to points previously unobserved concerning them.

EXPLANATION OF THE PLATES.

a, a', a'' = cellula vel semicellula a fronte visa.
b, b' = „ „ „ vertice „
c = „ „ „ latere „
d =semicellula a basi visa.

Plate XII.

Fig. 1, 2. *Gonatozygon aculeatum*, Hastings, forma *minor*. 1, 400/1; 2, 520/1.
3–6. *Phymatodocis Nordstedtiana*, Wolle, forma *minor*, Bœrg. 520/1.
7, 8. *Sphærozosma Aubertianum*, West. 520/1. Two zygospores.
9. „ *excavatum*, Ralfs, var. 520/1.
10. *Spondylosium pulchrum*, Arch., var. *inflatum*. 520/1.
11, 12. „ „ „ var. *constrictum*. 11, 170/1; 12, 520/1.
13, 14. „ *rectangulare*, nobis. 520/1.
15–17. *Onychonema læve*, Nordst., var. *micracanthum*, Nordst. 15, 16, 520/1; 17, 400/1. 16 and 17, two zygospores.
18. „ „ „ var. *latum*, n. var. 520/1.
19. *Gymnozyga moniliformis*, Ehrenb., var. *gracilescens*, Nordst. 520/1. Zygospores.
20, 21. „ *confervacea*, n. sp. 520/1.
22. „ *delicatissima*, Lagerh. 520/1.
23. *Desmidium aptogonum*, Bréb., var. *Ehrenbergii*, Rabenh. 520/1.
24. „ „ „ 520/1. Zygospores.
25. „ *quadratum*, Nordst. 520/1.
26, 27. „ *æquale*, n. sp. 520/1.
28. „ „ „ 520/1. Zygospore.
29. „ *cylindricum*, Grev. 520/1. Zygospore.
30. „ „ „ var. *obliquum*, n. var. 520/1.
31. *Pleurotænium nodosum*, Lund. Abnormal semicell. 170/1.
32, 33. *Penium minutum*, Cleve, var. *gracile*, Wille. 520/1.
34. „ *inconspicuum*, West. 520/1.
35. *Docidium baculum*, Bréb. 520/1.

Plate XIII.

Fig. 1. *Pleurotænium hypocymatium*, n. sp. 520/1.
2, 3. „ *subcoronulatum*, West, var. *detum*, n. var. 520/1.
4, 5. „ *trochiscum*, n. sp. 520/1.
6. „ *Sceptrum*, nobis. 520/1.
7, 8. „ „ „ var. *capitatum*, West. 520/1.
9–13. *Triploceras gracile*, Bail. 9, 400/1; 10–13, 520/1.
14, 15. *Closterium abruptum*, West. 14, 400/1; 15, 520/1. Zygospores.
16, 17. „ *Braunii*, Reinsch. 16, extremity, 520/1; 17, portion of membrane, 830/1.
18, 19. „ *Cynthia*, Not. 520/1.
20–22. „ *dilatatum*, n. sp. 20, 21, 520/1; 22, 220/1.
23, 24. „ *costatum*, Corda, forma. 520/1.
25, 26. *Cylindrocystis angulata*, n. sp. 520/1.
27. *Micrasterias arcuata*, Bail., var. *gracilis*, n. var. 400/1.

Fig. 28. *Micrasterias pinnatifida*, Ralfs. 520/1. Zygospore.
29. „ „ „ forma. 400/1.
30. „ *radiosa*, Ralfs, forma. 400/1.

Plate XIV.

Fig. 1. *Micrasterias depauperata*, Nordst. 400/1.
2. „ *furcata*, Ralfs, forma. 170/1.
3. „ „ „ „ 400/1.
4. „ *Nordstedtiana*, Wolle. 170/1.
5, 6. „ *muricata*, Bail. Two abnormal semicells. 220/1.
7. „ „ „ var. *tumida*, n. var. 400/1.
8, 9. „ *conferta*, Lund., var. *hamata*, Wolle. 520/1.
10, 11. „ *speciosa*, Wolle, forma. 400/1.
12. „ *apiculata*, Menegh. 170/1.
13–16. „ *abrupta*, n. sp. 13, 400/1; 14–16, 520/1.
17. *Euastrum insigne*, Hass. 520/1.
18, 19. „ *intermedium*, Cleve. 18, 400/1; 19, 520/1.
20, 21. „ *attenuatum*, Wolle. 520/1.
22. „ *evolutum*, nobis. 520/1.
23–25. „ „ „ var. *integrius*, n. var. 520/1.
26. „ *oculatum*, Bœrg., var. *tonsum*, n. var. 520/1.
27. „ *elegans*, Kuetz., var. *spinosum*, Ralfs. 520/1.
28. „ „ „ var. *bidentatum*, Naeg. 520/1. Zygospore.
29. „ *solidum*, n. sp. 520/1.
30. „ *subornatum*, n. sp. 520/1.
31. „ *Ciastonii*, Racib. 520/1.
32, 33. „ *validum*, n. sp. 520/1.
34. „ *trigibberum*, West. 520/1.
35. *Cosmarium Hammeri*, Reinsch, var. *protuberans*, n. var. 400/1. Zygospore.
36. „ *Baileyi*, Wolle, var. *major*, n. var. 520/1.

Plate XV.

Fig. 1. *Cosmarium balteum*, n. sp. 520/1.
2. „ *pseudopyramidatum*, Lund. 520/1. Zygospore.
3. „ *ovale*, Ralfs, var. *subglabrum*, n. var. 520/1.
4. „ *cosmetum*, n. sp. 520/1.
5, 6. „ *Favum*, n. sp. 5, 520/1; 6, single granule with surrounding structure, 830/1.
7. „ *Boeckii*, Wille, forma. 520/1.
8. „ *taxichondrum*, Lund., var. *angulatum*, n. var. 520/1.
9. „ *cyathiforme*, n. sp. 520/1.
10, 11. „ *dentatum*, Wolle. 10, 520/1; 11, portion of membrane, 830/1.
12. „ *subpulchellum*, n. sp. 520/1.
13. „ *amœnum*, Bréb., var. *compactum*, n. var. 520/1.
14. „ *ordinatum*, nobis. 520/1.
15. „ *subdepressum*, n. sp. 520/1.
16. „ *doliforme*, n. sp. 520/1.

Fig. 17. *Cosmarium globosum*, Bulnh., var. *Wollei*, n. var. 520/1. A semicell and a zygospore.
18. „ *subimpressulum*, Borge. 520/1.
19. „ *granatum*, Bréb., var. *ocellatum*, n. var. 520/1.
20. „ *Regnellii*, Wille. 520/1.
21. „ *contractum*, Kirchn., var. *papillatum*, n. var. 520/1.
22. „ *Eloiseanum*, Wolle. 690/1.
23. „ „ „ var. *depressum*, n. var. 520/1.
24. *Xanthidium tetracentrotum*, Wolle. 520/1
25. „ *fasciculatum*, Ehrenb., var. *oronense*, n. var. 520/1.

Plate XVI.

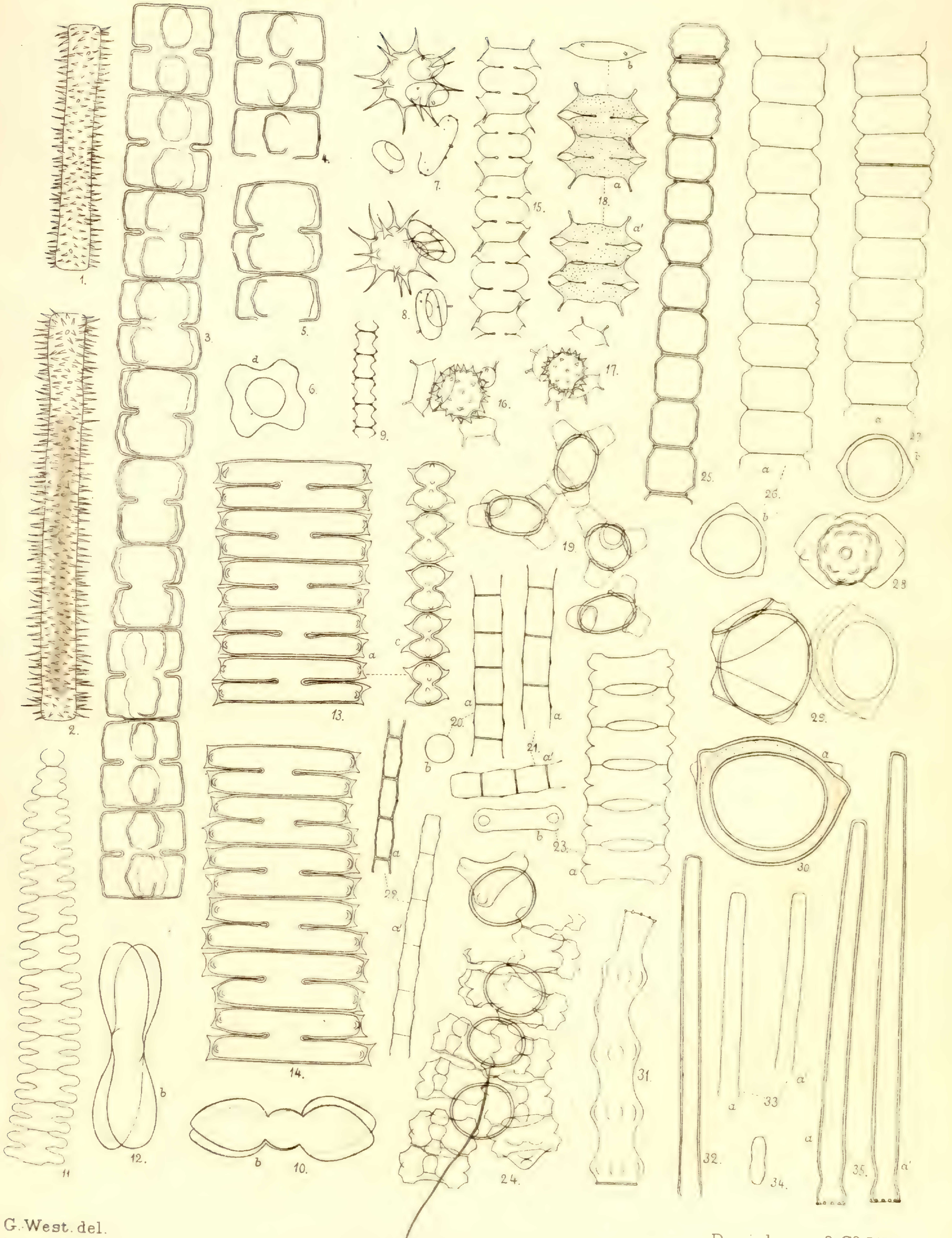
Fig. 1. *Xanthidium antilopæum*, Kuetz., forma. 520/1.
2. „ „ „ var. *canadense*, Josh. 520/1.
3. *Arthrodesmus convergens*, Ehrenb. 520/1. Zygospore.
4. „ „ „ var. *incrassata*, Gutw. 520/1.
5. „ „ „ var. *obesum*, n. var. 520/1.
6. *Staurastrum apiculatum*, Bréb. 520/1. Zygospore.
7. „ *connatum*, Roy et Biss., var. *americanum*, n. var. 520/1.
8. „ *glabrum*, Ralfs, var. 520/1.
9. „ *sibiricum*, Borge, var. *occidentale*, n. var. *a*, 520/1; *a′* et *b*, 625/1.
10. „ *aristiferum*, Ralfs, var. *parallelum*, n. var. 400/1.
11. „ *subscolopacinum*, nov. sp. 520/1.
12. „ *unicorne*, W. B. Turn., var. *obesum*, n. var. 625/1.
13. „ *abruptum*, n. sp. 520/1.
14. „ *inconspicuum*, Nordst. 590/1.
15. „ *Hantzschii*, Reinsch, var. *congruum*, nobis. 520/1.
16, 17. „ *quadrangulare*, Bréb. 16, 625/1; 17, 520/1.
18. „ „ „ var. *armatum*, n. var. 520/1.
19. „ *contectum*, W. B. Turn., var. *inevolutum*, W. B. Turn. 520/1.
20, 21. „ *trifidum*, Nordst. 20; 400/1; 21, 595/1.
22. „ „ „ var. *inflexum*, n. var. 520/1.
23. „ *spicatum*, West & G. S. West. 520/1.
24. „ *subtrifurcatum*, n. sp. 520/1.
25. „ *claviferum*, n. sp. 520/1.
26. „ *Brebissonii*, Arch., var. *heteracanthum*, n. var. 520/1.
27. „ *setigerum*, Cleve, var. *occidentale*, n. var. 520/1.
28. „ „ „ var. *pectinatum*, n. var. 520/1.
29. „ *trihedrale*, Wolle. 520/1.
30. „ „ „ var. *rhomboideum*, n. var. 520/1.
31. „ *grande*, Bulnh., var. *rotundatum*, n. var. 400/1.
32. „ *brachiatum*, Ralfs. 520/1. Zygospore.
33. *Dichotomum elegans*, nov. gen. et sp. 520/1.
34. *Staurastrum arcuatum*, Nordst., forma *aciculifera*. 520/1.
35. „ *sexverrucosum*, n. sp. 520/1.
36. „ *validum*, n. sp. 520/1.
37. „ *delicatissimum*, n. sp. *a* et *d*, 520/1; *b*, 830/1.

Plate XVII.

Fig. 1. *Staurastrum parvulum*, n. sp. 520/1.
2. " *genuflexum*, n. sp. 595/1.
3, 4. " *subgracillimum*, n. sp. 520/1.
5. " *asteroideum*, n. sp. 520/1.
6. " *bicoronatum*, N. L. Johnson, var. *simplicius*, n. var. 520/1.
7. " *incisum*, Wolle, var. *effiguratum*, n. var. 400/1.
8. " *logimum*, n. sp. 520/1.
9. " *paradoxum*, Meyen, var. *osceolense*, Wolle, f. *minor*. 520/1.
10. " *aspinosum*, Wolle, var. *annulosum*, n. var. 520/1.
11. " *barbatum*, n. sp. 520/1.
12. " *brachioprominens*, Bœrg. 520/1.
13. " " " var. *robustum*, n. var. *a*, 520/1 ; *a'* et *b*, 625/1.
14. " *natator*, West, var. *crassum*, n. var. 520/1.
15. " *grallatorium*, Nordst., var. *americanum*, n. var. 520/1.
16. " *Johnsonii*, n. sp. 520/1.
17. " *leptocladum*, Nordst., var. *insigne*, n. var. 520/1.
18-20. " *ornithopodum*, n. sp. 520/1.
21, 22. " *Anchora*, n. sp. 520/1.
23. " *longiradiatum*, n. sp. 520/1.

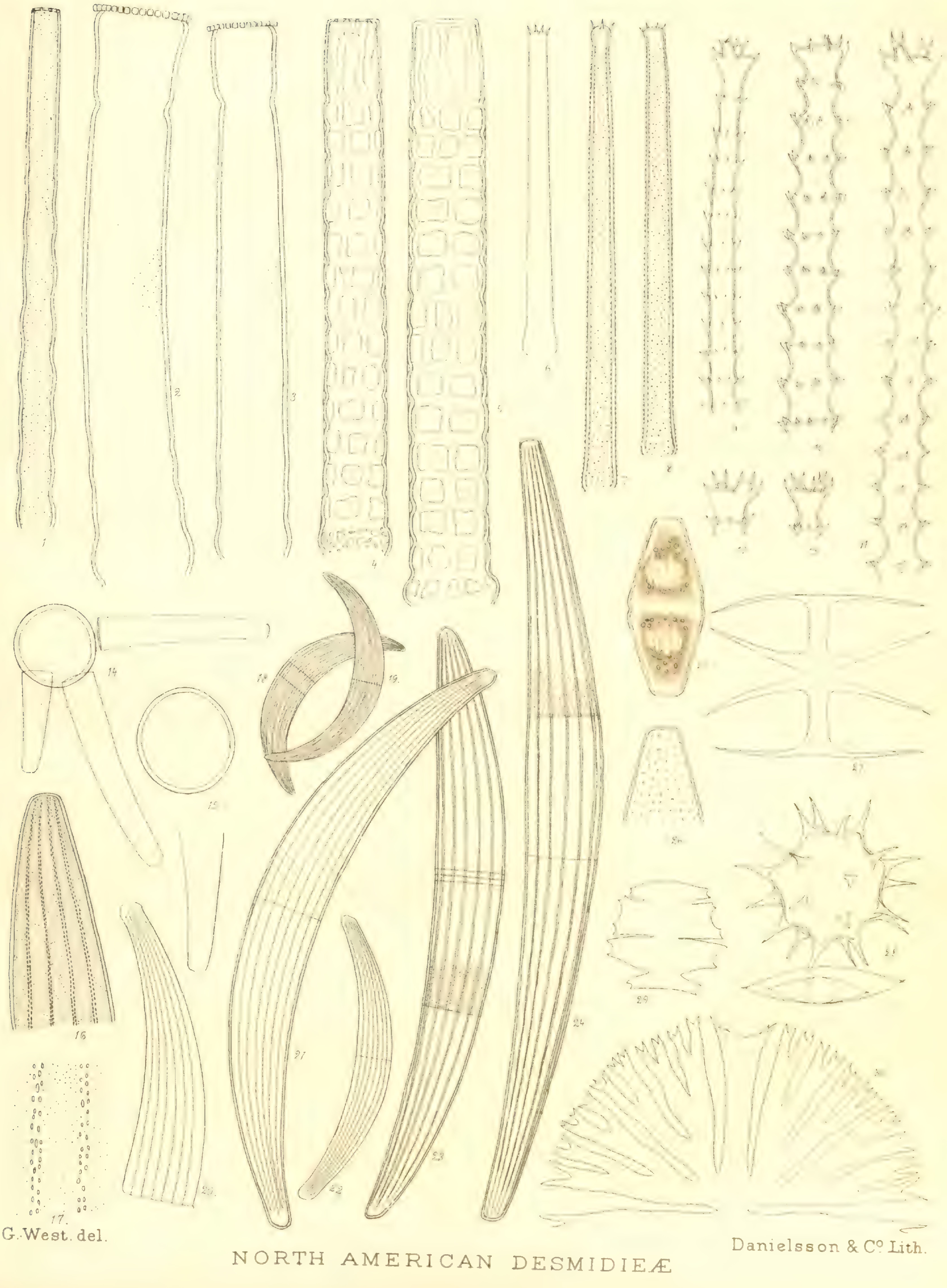
Plate XVIII.

Fig. 1. *Staurastrum floriferum*, n. sp. 520/1.
2, 3. " *Sebaldi*, Reinsch, varieties. 520/1.
4. " *Cerastes*, Lund. 520/1.
5. " *Zygæna*, n. sp. 520/1.
6. " *leptacanthum*, Nordst., var. *dodecacanthum*, n. var. 520/1.
7. " *xiphidiophorum*, Wolle, var. *brachyacanthum*, n. var. *a*, 595/1 ; *a'*, *a''*, et *d*, 520/1.
8. " *Wolleanum*, Butler, var. *intermedium*, n. var. 400/1.
9. " " " var. *kissimense*, Wolle. 520/1.
10. " *verrucosum*, n. sp. 520/1.
11. " *Rotula*, Nordst. 520/1.
12. " *subscabrum*, Nordst. 520/1.
13. " *Dickiei*, Ralfs, var. *maximum*, West. 520/1.
14. " *Arctiscon*, Lund., var. *glabrum*, n. var. 520/1.
15. " *minnesotense*, Wolle. 520/1.
16. " *Ophiura*, Lund., var. *tetracerum*, Wolle. 520/1.
17. " *quadrispinatum*, W. B. Turn. 520/1. *a'* is slightly tilted.
18. " *quadricornutum*, Roy et Biss. 520/1. An abnormal semicell.



G. West. del. Danielsson & Co. Lith.

NORTH AMERICAN DESMIDIEÆ



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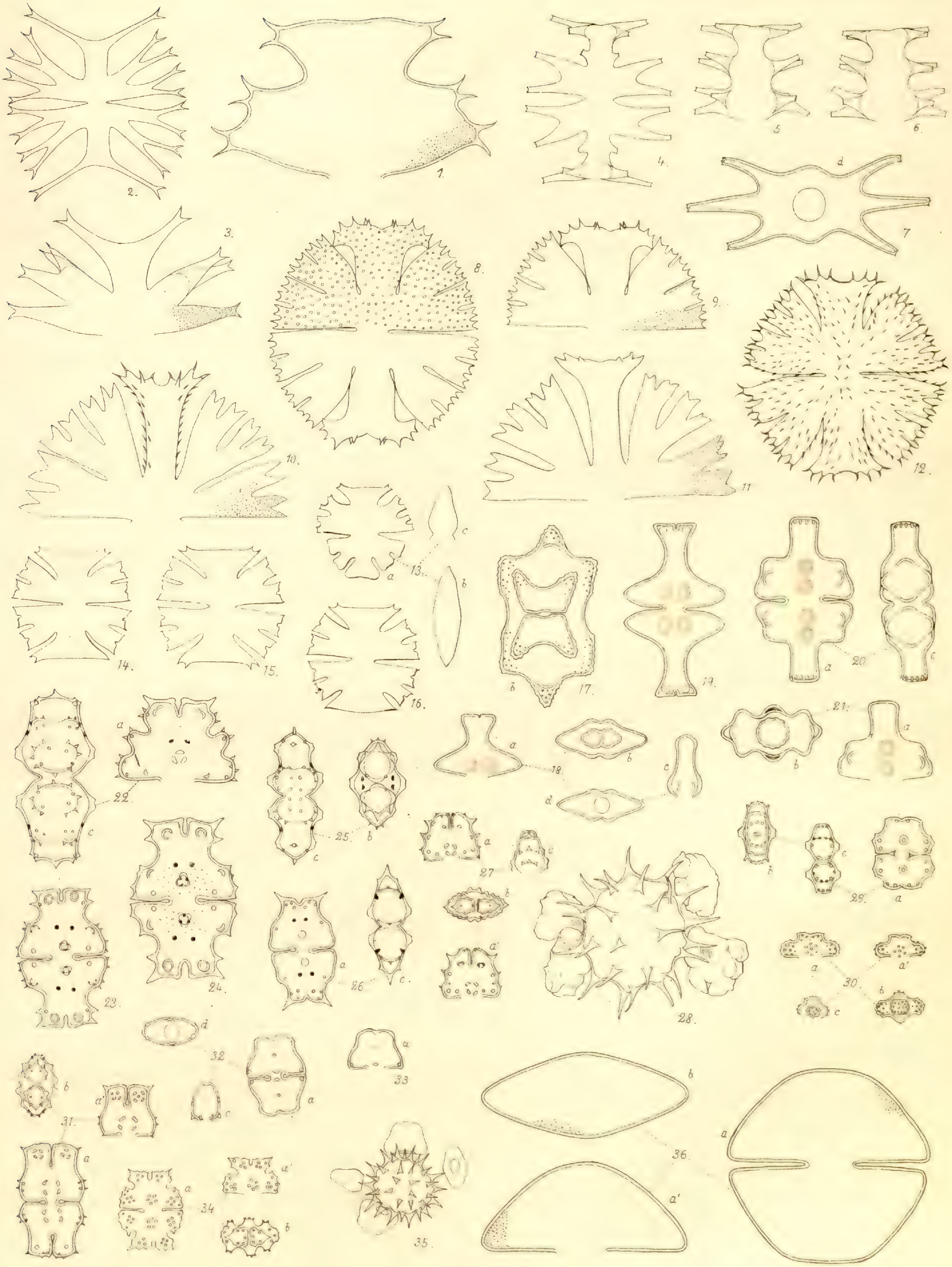

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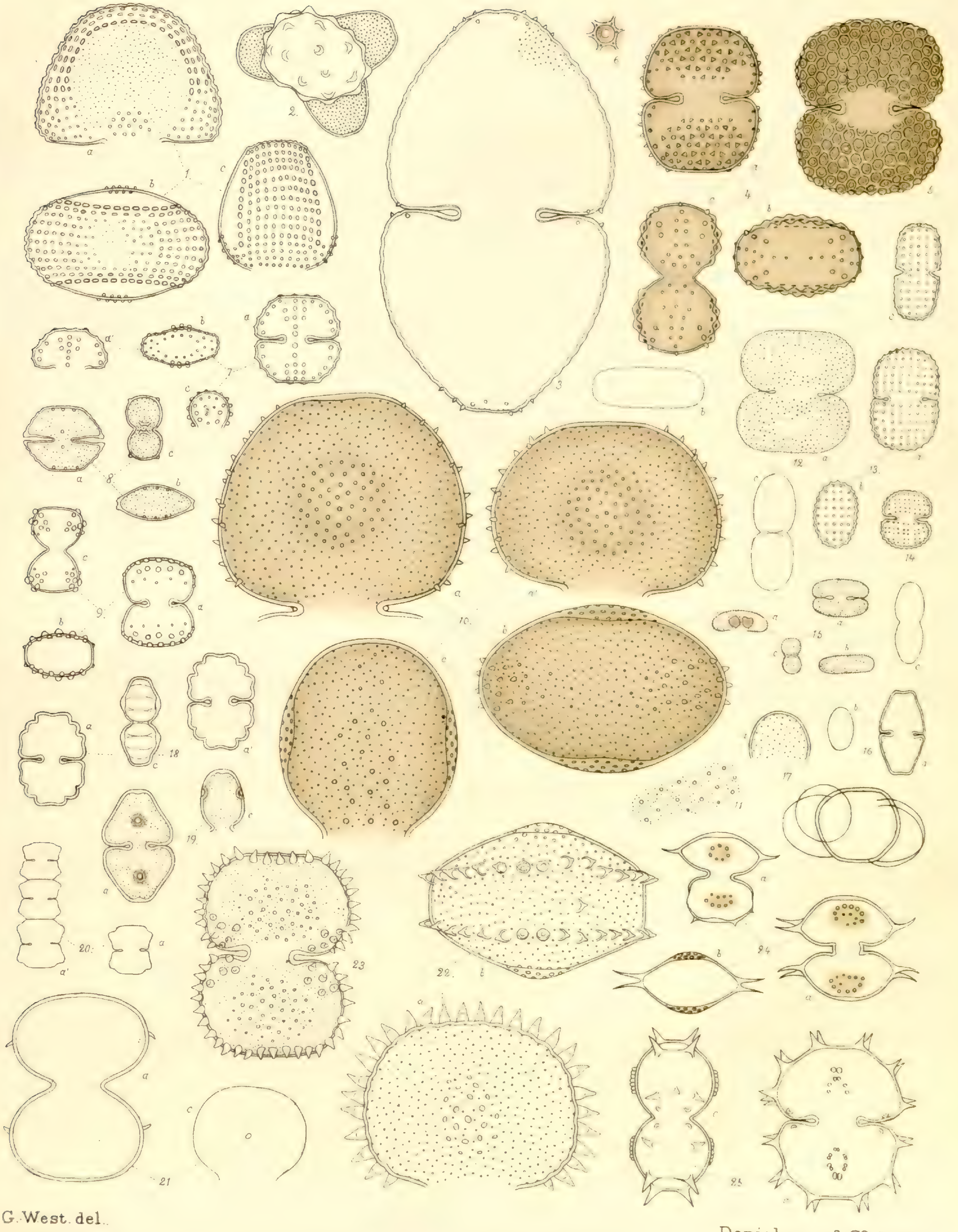

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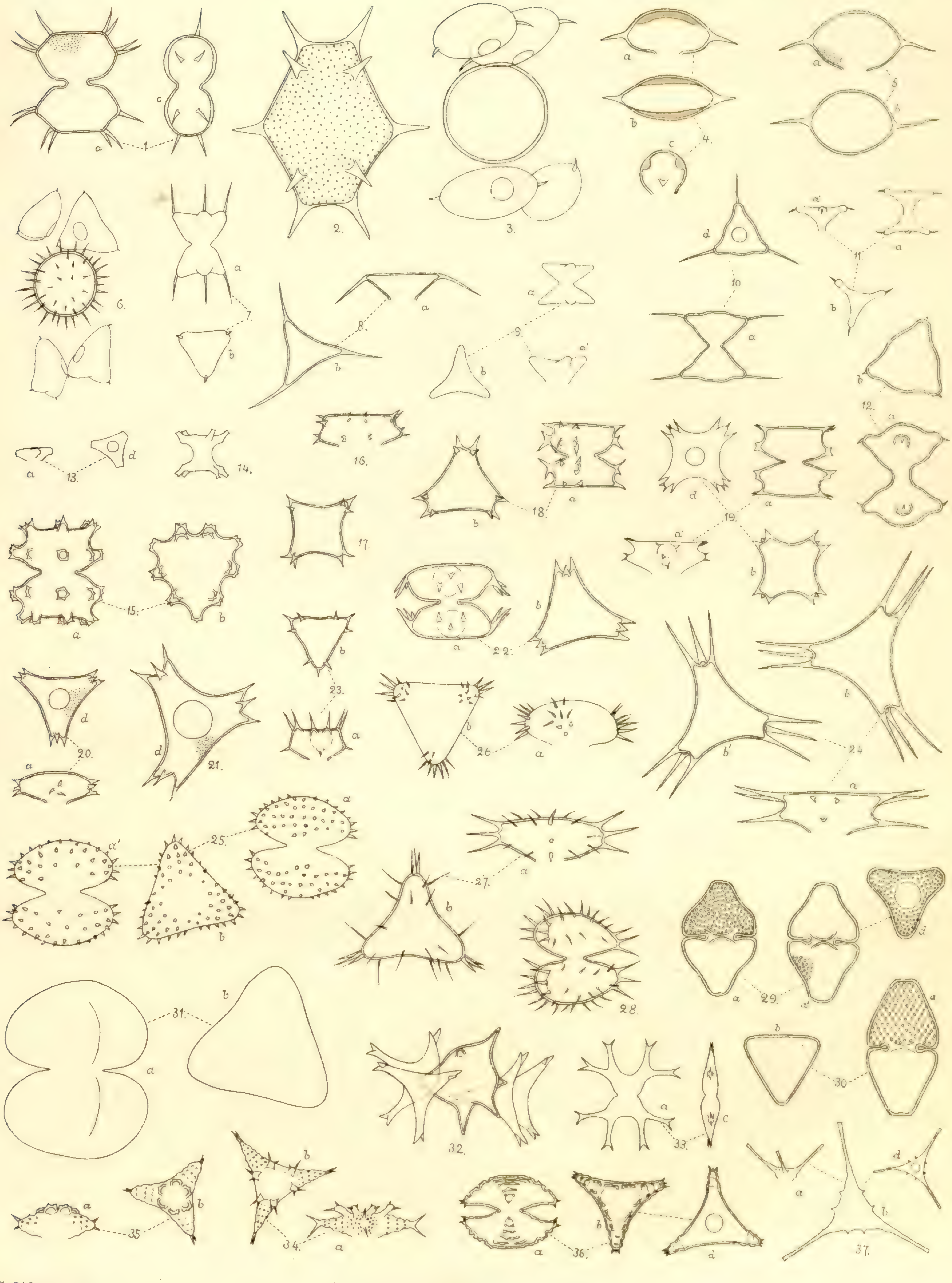

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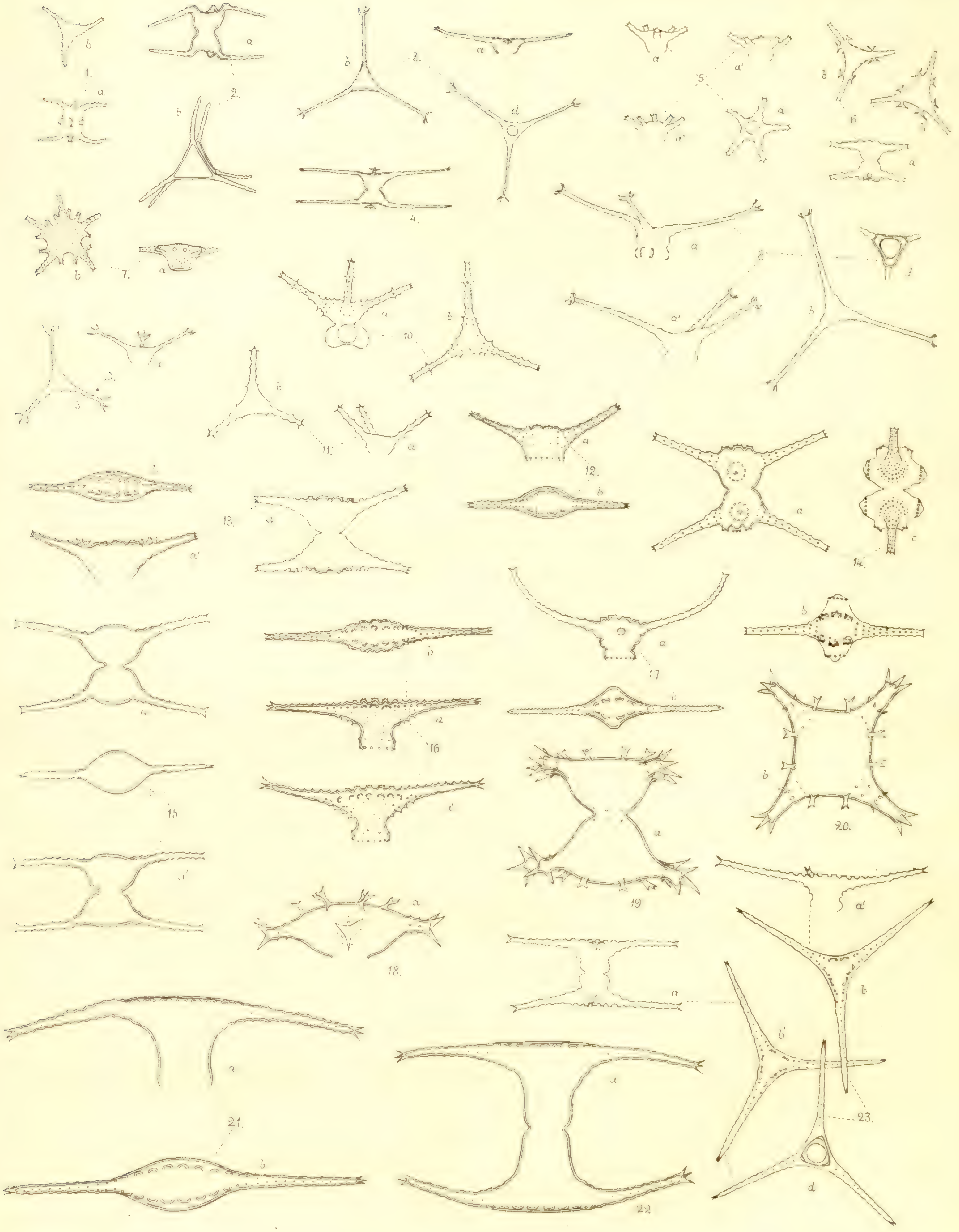

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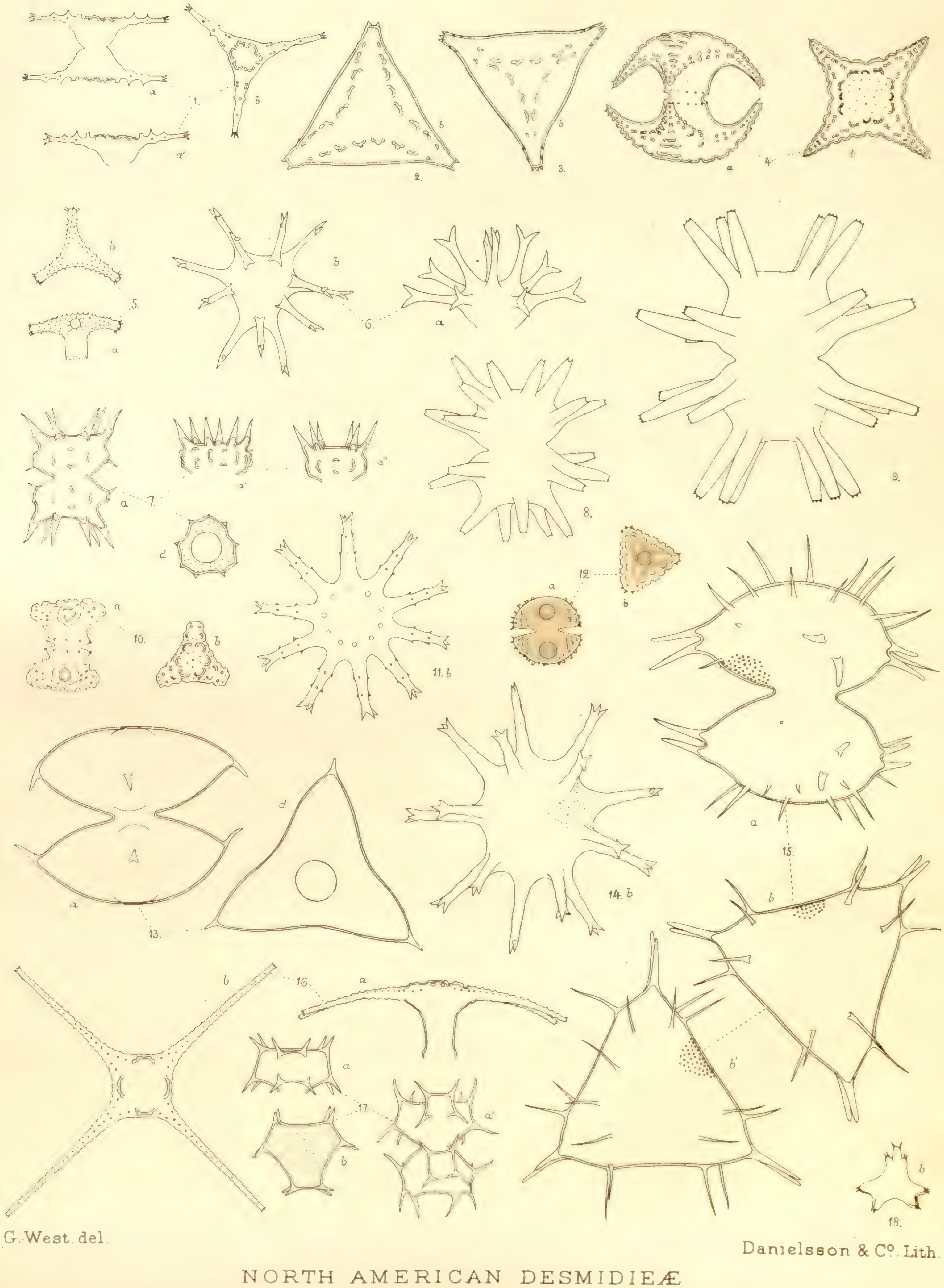

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LINNEAN SOCIETY OF LONDON.

MEMORANDA CONCERNING TRANSACTIONS.

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	Part III.	1896.	0	6	0	0	4	6
	Part IV.	1896.	1	0	0	0	15	0
	Part V.	1896.	0	14	0	0	10	6

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TRANSACTIONS

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THE LINNEAN SOCIETY OF LONDON.

ON POLYSTELIC ROOTS OF CERTAIN PALMS.

BY

B. G. CORMACK, M.A.

(*Communicated by* D. H. Scott, F.R.S., F.L.S.)

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November 1896.

VI. *On Polystelic Roots of certain Palms.* *By* B. G. Cormack, *M.A.* (*Communicated by* D. H. Scott, *F.R.S.*, *F.L.S.*)

(Plates XIX. & XX.)

Read 6th February, 1896.

It is a striking fact that throughout the vascular plants, however great the differences in the reproductive system and in the vegetative shoot, there is, nevertheless, a general sameness in the form and structure of the root.

This uniformity which characterizes the root is ultimately to be correlated with the uniformity of its function and environment. Botany and zoology alike afford many illustrations of the correlation between fixity in highly symmetrical environment and radial symmetry.

Van Tieghem made the root a starting-point for study of the symmetry of vascular plants, and has arrived at a new classification of tissues, involving the morphological conception of the *stele.* His views on the subject are now common property of botanists. His description of the polystelic condition of stems of *Pteridophyta* and of certain *Spermaphyta* has thrown a new light upon structures which were previously of a very puzzling nature. Roots, however, show, almost without exception, one normal central vascular cylinder or stele. Two exceptional forms are recognized and classed as polystelic, certain tuberous roots belonging to the Cycadaceæ and Leguminosæ respectively; and with polystelic roots must be classed certain abnormal Palm-roots now to be described.

The investigation was carried out on material from the collection made by Professor Bower in Ceylon, supplemented by specimens obtained during the re-potting of Palms in the Botanic Gardens of Edinburgh and Glasgow.

Thin normal roots of *Areca Catechu,* Linn., about 2 millim. thick, show a central stele of small diameter as compared with the thickness of the cortex. The proportions are indicated by Pl. XIX. fig. 1. The piliferous layer is, at least in places, cuticularized. The underlying cells of the cortex are sclerotic, forming an outer zone without intercellular spaces. From this there is a transition to an inner, thicker, more parenchymatous zone traversed by thick-walled sclerenchyma-cells. The rounded parenchyma-cells have the usual intercellular spaces between them; but in addition to these air-passages there are large radial rifts in the tissue, which extend between plates of cells twelve or even twenty deep radially. These rifts do not extend inward to the endodermis; thus the inmost layers of cortical parenchyma form a zone four or five cells thick, showing only the usual intercellular spaces. The endodermis is normal, a continuous zone of cells with stratified, pitted, lignified walls, thickened chiefly on the radial, inner-tangential,

and transverse walls. Thus most of the endodermal cells are thickened on five walls, but the usual thin-walled cells may be seen in the neighbourhood of protoxylem-groups.

The vascular cylinder is normal, central, and, proportionately to the cortex, small and concentrated, especially in comparison with thicker *Areca*-roots. Its conjunctive tissue is an uninterrupted mass of sclerenchyma; even the walls of the pericycle are mostly thick and woody.

The xylem- and phloem-strands have the usual radial arrangement. The xylem-groups are single and **I**-shaped or paired, and **V**- or **Y**-shaped, with a phloem-group in the fork; the significance of this variation will be subsequently referred to. The youngest vessels of the xylem-groups are large and constitute a conspicuous central ring.

Thicker roots of *Areca*, say about a centimetre in diameter, can be found, which are practically normal in structure. In these the cortical zone is relatively less bulky than in the thinner roots, and consequently the vascular cylinder is proportionately nearer the periphery. The piliferous layer and enclosed layers of the cortex are essentially the same as in the thinner roots. The cell-layers towards the periphery are thicker and more obviously sclerotic. The sclerenchyma-fibres of the deeper cortex are grouped in strong, definite strands, and the radial rifts are larger and more numerous.

With the large size and peripheral position of the vascular cylinder is associated the development of more numerous groups of xylem and phloem. These groups are larger than in thinner roots, yet the difference in size is not sufficient to bring the youngest vessels so near the centre. The conjunctive tissue is significantly different from that of the thin root just described. It does not extend to the centre as a continuous sclerenchymatous mass, but is so constructed as to leave a deeply-fluted central column, chiefly of parenchyma. Thus the arrangement of tissue is such as to show in transverse section sector-shaped masses of sclerenchyma united together and traversed by phloem and xylem proper, some of the phloem-groups being situated at the ends of the radiating arms of pith. In some sections, traversing the medulla there may be seen isolated strands of xylem surrounded by sclerenchyma, and sometimes accompanied by strands of phloem.

Thus far the structure of *Areca*-roots is seen to agree with Mohl's description of Palm-roots in general. At this point it may be noted that Mohl ('De Structura Palmarum,' Engl. transl. p. 49) wrote: "the cells immediately surrounding the central body contain on their inner side transverse fibrous thickenings like many anther cells," describing in these words the tissue now classified under the name endodermis.

A third type of section may be distinguished which differs from that just described only in that the vascular mass or stele is not a smooth cylinder or cone, but a longitudinally furrowed column; conformably with this the endodermis does not appear as a smooth circle in transverse section, but has a wavy outline; it is, however, perfectly continuous.

The kind of structure referred to as type three has been described for the roots of *Iriartea*. Mohl (*loc. cit.*, Engl. transl. p. 50) wrote: "In the upper parts of many palm-roots, e. g. *Phœnix*, *Cocos*, fibrous bundles are scattered through the rind, while no trace of them is found in others. But the rather thick root of *Iriartea exorhiza* exhibits

more important deviations. A cross-section of it presents to the naked eye a star composed of brown lines, with obtuse, mostly bifid, rays. The microscope shows that this star is formed of crowded vascular bundles. Besides these, scattered vascular bundles occur singly in the centre of the star, but a central cord, like that of the other palm-roots, is wanting."

To this Hermann Karsten, who also gives a figure of the root (Die Veget. Palm., plate iii. fig. 3, and p. 63), replied that on comparing the structure described with the roots of the other Monocotyledons he should not have expected to find a central strand.

De Bary, grasping the relationship, wrote (Vergl. Anat., Engl. transl. p. 362) thus :—

"The roots of *Iriartea,* finally, which are an inch in thickness, are distinguished from those last described, first by the fact that their bulky vascular mass is not cylindrical, but deeply furrowed, having in cross-section the form of a star with about ten blunt and usually bifid rays; further by the fact that the radial ring also is divided up into sclerenchymatous bundles, enclosing the vessels and phloem-groups, and radial bands of parenchyma, which are sometimes narrow, 1–2 layers in thickness, sometimes many-layered, and which separate the bundles from one another. The middle of the star also consists mainly of thin-walled parenchyma, often with lacunæ, which is directly continued into the radial bands of the ring, and in which bundles of sclerenchyma, each containing one or more vessels and phloem-groups, lie scattered. Inside each sclerenchymatous bundle the vessels are surrounded by 1–2 layers of parenchymatous cells, those of them which belong to the ring standing in direct connection with the many-layered pericambium. An endodermis, which is thickened here and there, appears according to Mohl's figure to surround the star. Finally, in the entire parenchyma, both of the star and of the cortex which surrounds it, numerous small bundles of sclerenchymatous fibres lie, each enclosing in its centre 1–2 thin-walled elongated elements (perhaps sieve-tubes ?). The xylem-plates in the ring appear short and irregular in cross-section ; their radial arrangement and alternation with the phloem-plates is according to Mohl's figure often indistinct, though in general to be recognized. The development of the elements, both in *Iriartea* (Karsten) and in the roots of *Pandanus*, begins at the periphery of the ring, and in general proceeds centripetally. According to all these phenomena, the series of large roots just described are immediately connected with the type of monocotyledons as special cases, in which the anatomical differentiation becomes more varied, with the more considerable size."

A fourth type of transverse section of *Areca*-root may be recognized, in which the xylem, phloem, and appertinent sclerenchyma do not constitute an undivided column, but, on the contrary, form distinct masses having the structure and position of the outer parts of a series of steles, small in diameter. Conformably with this arrangement the endodermis is discontinuous, and shows as arcs of small circles (Pl. XIX. figs. 3, 4, 5).

In a fifth type, in place of some of the portions of small steles, there are entire steles surrounded by a complete endodermis ; and thus, in transverse section, complete circles of endodermis, corresponding with the arcs of small circles seen in the fourth type. The type is, in fact, polystelic (figs. 6, 13).

Between these five types there is continuity of transition. In fact, figs. 2, 3, 4, 5 are diagrams representing transverse sections taken from one somewhat tapering root.

Fig. 5 represents a transverse section cut at a distance of 150 millim. from the apex. The incomplete endodermis appearing as small arcs indicates that the structure is that of type four.

Fig. 4 shows a stage in the transition as seen in a section cut 115 millim. from the apex.

Fig. 3 illustrates that at 77 millim. from the apex the structure is simpler and approximates to that of type three, which has a single endodermis complete and wavy in its outline.

Fig. 2 was drawn from a section cut 15 millim. from the apex, where the structure is another stage in the transition, being practically that of type two.

The root from which fig. 6 was drawn had not attained sufficient length to illustrate fully the transition between complex and simple structure. However, between two transverse sections from parts not far separate considerable difference in degree of complexity could be seen. With a wider field for search a single root might well be found exhibiting at successive points examples of each of the five structural types which have just been distinguished for convenience.

This raises the question as to the nature of the histological changes associated with morphological differences in successive parts of an individual root. Two explanations offer themselves for examination :—

1st. Secondary changes may have produced the complex abnormality.

2nd. The apical meristem may have undergone continuous change in its mode of differentiation. According to the first view an abnormal part was once normal: according to the second it never was.

The fact that greater complexity is found in the basal older parts, less complexity in younger apical regions, with continuity of transition, is not at variance with either view.

The histological evidence obtained in the examination of these views is illustrated in part by Pl. XIX. figs. 7, 8, 9, 10, 11, 12.

Figs. 7, 8, 9 are diagrams showing the disposition of tissues in the neighbourhood of the points indicated by the arrows in the diagrams 3, 4, 5 respectively. Xylem and sclerenchyma are shaded dark; phloem and parenchyma, light. Larger vessels of the wood are shown unshaded and with double contour lines; large intercellular spaces, unshaded and with dotted contours. Endodermis is represented by a dark line.

Figs. 10, 11, 12 are drawings illustrating in greater detail tissues round the points indicated by the arrows in figs. 3 and 7, 4 and 8, 5 and 9 respectively.

If, according to the first view, increased complexity results from secondary changes, modifying dispositions which were simpler when younger, careful observation should detect histological evidence of such change; but the only peculiarities noticeable are such as might be expected from the development of sclerenchymatous masses in the neighbourhood of parenchyma.

Against this view, then, there is the negative evidence that, hypothetically, changes of great complexity, seemingly without parallel in any shoot, have been accomplished without leaving any trace of the process.

Further, there is evidence of a more positive character. The transverse section repre-

sented in fig. 3, cut 77 millim. from the apex, shows about one hundred groups of protoxylem; while a section 150 millim. from the apex (fig. 5) shows more than one hundred and twenty distinct groups; and cases more extreme could be cited. It is scarcely conceivable that secondary changes could accomplish this increase of a tissue like protoxylem-groups.

Thus the first explanation seems to be inconsistent with the evidence from anatomy and to have no parallel in any shoot. The second view, on the contrary, is consistent with both lines of evidence. Developmental studies have made familiar the idea of the apical meristem of a shoot altering its mode of differentiation while forming successively younger parts. For example, as regards vascular bundles with their protoxylem-groups, there is a numerical increase, as the plumule of a monocotyledon undergoes development; and there is numerical decrease in later-formed portions of an axis of *Equisetum*. Further, as regards steles, Leclerc du Sablon has shown that in many ferns, such as *Pteris*, a series of transverse sections of the same stem shows a change in number. It is true that in this case the number of steles increases in successively younger portions; but there is ultimately reduction to a single stele in *Nephrolepis*, and also in *Gunnera* and in *Primula Auricula*, as recorded by Van Tieghem and Douliot.

The following account of the changes in the mode of development of successively younger portions of complex Areca-roots is true also of roots of certain Palms to be mentioned afterwards. The changes are in part illustrated in the figures just referred to.

As regards the structure of the apex of these roots seen in longitudinal section, thin normal roots conform to the triacrorhize type usual in Monocotyledons; thicker roots show a structure which would doubtless be described by Van Tieghem as an "enchevêtrement de trois sortes d'initiales," a condition which, from Sachs's standpoint with regard to the disposition of walls in apical meristems, might well be expected.

In the transverse section of the older part of a root there may be several perfect steles, each surrounded by a complete endodermis, showing as circles; and also imperfect steles showing as arcs. These perfect steles are continued into younger parts in the form of imperfect steles with incomplete endodermis. Further, the imperfect steles are continuous with the single central stele of still younger portions, which includes for some distance isolated vascular strands in its pith.

In the course of the gradual transition to simplicity of structure, Y- or V-shaped groups of xylem become I-shaped, as a limb may cease to be developed in the younger portions, and correlatively the two phloem-groups that flanked the suppressed limb are, in the succeeding portions, represented by a single strand.

Further, two I-shaped groups of xylem with their surrounding sclerenchyma may be convergent in the younger portions, thus forming Y- or V-shaped groups with one surrounding mass of sclerenchyma.

Vascular groups forming the edges of imperfect steles are continued towards the apex as isolated strands traversing the pith; these strands consist of xylem and sclerenchyma, accompanied sometimes by phloem; they gradually cease to be developed, phloem earlier, xylem later; see isolated strand, *i.str.* in figs. 9, 8, 7.

The endodermis accompanying each imperfect stele is incomplete as such, merging

into sclerenchyma; and corresponding with the continuous change to the single large stele, there is a gradual change to the complete endodermal system of the normal root.

The changes just described seem best explained by assuming that in successively younger portions of the root the apical meristem has continuously changed its mode of differentiation.

With regard to other Palm-roots examined, roots of *Cocos nucifera*, Linn., were found showing, in all essential points, correspondence with the roots of *Areca* just described; the sclerenchymatous development was even stronger than that of *Areca*.

The very thick root of *Verschaffeltia splendida*, H. Wendl., available for examination showed an extraordinary degree of complexity represented diagrammatically in Pl. XX. fig. 14. The diameter of the diagram is twice that of the root. Fig. 15 shows one of the perfect steles—the stele indicated by *st.* in fig. 14; the magnification and scheme of lettering and shading are the same as in figs. 7, 8, 9. Fig. 14 indicates, so far as the very small scale will admit, the result of observations made under the same magnification as figs. 7, 8, 9.

Roots of other Palms were examined with the following result:—

Type Four.	*Seaforthia elegans*, R. Br. (*Ptychosperma elegans*, Blume).
Type Three.	*Dypsis*, sp.
	Euterpe edulis, Mart.
Type Two.	*Ptychosperma filifera*, H. Wendl.
	Ptychosperma Cunninghamii, H. Wendl.
	Hyophorbe Verschaffelti, H. Wendl. (*Areca Verschaffelti*, Hort.).
	Kentia Fosteriana, F. Muell.
	Caryota sobolifera, Wall.
	Geonoma pumila, Lind. et H. Wendl.
	Corypha australis, R. Br.
	Livistona chinensis, R. Br.
	Phœnix dactylifera, Linn.
	Phœnix sylvestris, Roxb.

As the range of specimens available for examination was very limited, it by no means follows that the degree of complexity just noted is the maximum for each species in question.

With regard to the physiological aspect of these various types of root-structure, reference has already been made to the correlated prevalence of uniformity in structure, function, and environment among roots; there remains for consideration the problem of adaptation in a few of its aspects interesting from the present standpoint.

As a living organ, the root respires and fulfils the special functions of absorption, conduction, insinuation, fixation. The root of a young plant must perform these and other subsidiary duties; and the problem of adaptation is most complex, involving a combination of delicacy, slenderness, and strength.

A root-system of an older plant, especially one with marked secondary changes, shows

greater differentiation and integration; and the problem changes as some of the functions become chief duties of the older parts.

A young root is long and slender, exposing a relatively large surface favourable to absorption and respiration; the cylindrical form exhibits this surface on all sides, and gives the concentration of bulk, which combines strength with a slenderness and flexibility that facilitates insinuation.

Length of root necessitates an efficient system of transport, in which the passage alike of crude and elaborated materials is protected from interruption due to bending or to pressure from without. The pressure which must sometimes act on roots is considerable, and it is the deeper-lying younger portions that will be most affected; the growth of the root itself sets up pressure, and consequent caking of the surrounding soil has been recorded. Against such pressure the relatively thick cortex provides a cushion at once efficient and flexible. The xylem, by its peripheral position in the vascular cylinder, and by its centripetal development, is placed as near the absorptive system as is consistent with safety; at the same time the phloem-strands obtain additional protection from their sunken position in grooves between the xylem-groups. As regards avoidance of pressure on the phloem, the advantage afforded by an arrangement in which the phloem is hidden between plates of woody tissue, as compared with the disposal of the phloem in a sheath round the xylem, is well illustrated in the structure of many climbing stems, where, as in the case of roots, the risks arising from lateral pressure are serious; thus, for example, in several Asclepiadaceæ and Apocynaceæ the phloem-strands are sheltered in peripheral grooves of the wood.

This advantageous arrangement is seen even in some of the abnormal roots of *Lycopodium* and of *Ophioglossum*, where the xylem takes the form of a crescent enclosing a phloem-group; but it is most apparent in polyarch roots.

Simultaneously, this arrangement safely and inexpensively meets strains due to tension; for there is a concentration of the more resistant tissues into a central strand; thus also the centripetal development of the xylem affords the further advantage of adding more woody tissue as greater demands are made on the young root. This tendency to concentration of woody tissue is seen in the rarity of a parenchymatous pith: either the xylem-plates approximate towards the centre, or the conjunctive tissue is largely a sclerenchymatous matrix for the vascular strands.

Such is the scheme of construction in a normal root unaffected by secondary changes, which attains a compromise between such incompatible conditions as exposure of surface with concentration; slenderness, flexibility, and delicacy with strength; together with due prominence of structures requiring shelter.

In plants having a secondary thickening, the function of mechanical support is undertaken by fit increase in older parts which no longer require to perform the duty of insinuation.

Loss of liquid in transport is hindered by the relative decrease of surface consequent on increased diameter, and further by the development of cork, the duty of absorption now devolving on younger parts of the root. The concomitant loss of facilities for respiration is compensated by the formation of pneumatodes, such as lenticels.

Schwendener and his school have shown that, while concentration of the mechanical tissues into a central strand adapts an organ to withstand tensions, a more peripheral position is advantageous in resisting bending; and Warming and G. Karsten have illustrated this by showing the correlation between stem-like function and stem-like structure in adventitious roots of Rhizophoraceæ.

Thus in roots with cambial developments there are changes amounting almost to a reconstruction on a different plan, together with a redistribution of duties. On the other hand, the Palm-roots in question undergo no such reconstruction, and the plants depend on having their earlier root-system supplemented and replaced by an adventitious system. The older roots are not altered: they are replaced by new and suitable roots. Of this nature are the complex roots at present under consideration. While the root of an oak begins thin and gradually grows thick towards the base, the roots in question begin thick, and grow thin towards the apex. In general there is a correlation between the presence of cambial growth and the absence of polystelic increase; here there is a bulky primary polystelic development and a gradual return to normal root-structure.

The figures show that the vascular system lies proportionately much nearer the periphery than it does in a young normal root: with this may be compared the disposition, similar from a mechanical standpoint, attained in other plants through secondary thickening. But the mechanical tissue is disposed centrally as well as peripherally, after a fashion which Schwendener and Haberlandt have shown enables an organ to withstand either flexion or tension. The sclerenchyma-strands previously mentioned are well fitted to resist such tensions. The peculiar disposition of the tissues comes out very clearly in the root of *Verschaffeltia* previously referred to and illustrated diagrammatically in Pl. XX. figs. 14 & 15. While capable of resisting flexion, the structure seems best adapted for resisting tensions as a rope would. The roots seem, on the whole, more of the nature of stays than props; but at first, before they have firmly fixed themselves in the ground, they must be mainly props.

As successively younger portions of the root are developed, the mode of differentiation of the meristem continually changes; the root anticipates its entry on normal environment and duties, and assumes normal root-structure. In this condition there is the relatively thick cortex, more or less sclerenchymatous, and possessing the strong endodermis, one of whose functions Schwendener has shown to be mechanical. The main mass of sclerenchyma, however, is the conjunctive tissue of the vascular cylinder, including the large pith.

From the observations thus described it will be seen that certain roots may show the unusual condition of a polystelic structure: further, that in an individual root there is a transition from a polystelic condition, through various stages previously mentioned as types, to normal monostelic form, with concentration of the mechanical tissues into a central strand adapted to withstand the strains to which roots are usually subjected.

The large radial rifts previously mentioned form an aerating system; their presence and size are to be correlated with the large bulk and relatively small surface of the roots, together with the continuity of the peripheral zone of sclerotic tissue uninterrupted by such openings as lenticels.

Warming has described a system of intercellular spaces in the aerial roots of *Rhizophora Mangle*, Linn., to which he ascribes the function of helping to float the young plants; and shows that these spaces are kept distended by the presence in them of branched cells (*trichoblasts*), and that in this way collapse due to the heat of the sun may be avoided.

G. Karsten makes further mention of such intercellular spaces in the Rhizophoraceæ, and recognizing their function calls them "*pneumatophores*." In this he coins a word having analogy with the term "*pneumatode*," which Jost has applied to all openings of the nature of lenticels or stomata. G. Karsten mentions Palms also in which pneumatophores occur. In the case of the Palm-roots in question, there are no trichoblasts, and the duty of keeping the spaces open can scarcely be ascribed to the sclerenchyma-strands. On the other hand, it must be noted that the spaces are very much larger than those of the Rhizophoraceæ; and, further, the peripheral sclerotic ring previously mentioned guards against collapse. Similarly, as G. Karsten has shown, a woody ring aids in preventing obliteration by compression in the case of the Rhizophoraceæ. It may be that the development of sclerenchymatous strands or trichoblasts leads up to the formation of the intercellular spaces associated with them.

There remains to be pointed out the surprising increase of facility for movement of a body of air due to even a slight increase in diameter of a pneumatophore. Fluids, whether liquids or gases, have, owing to their viscosity, a different mode of flow in wide and in narrow channels. The speed with which a body of fluid can be transferred through a capillary tube increases as the fourth power of the tube's diameter. As it is evident from the work of Clerk Maxwell and others that this is true for gases as well as liquids, the advantage of increase of diameter of the pneumatophores is obvious.

In the Palm-roots examined nothing of the nature of pneumatodes was discovered. This finds a parallel in G. Karsten's observation that while other Rhizophoraceæ have pneumatodes in the roots, especially at places of branching, species of *Ceriops* have none in the root, but have them on the stem close to the ground.

It is not likely that, in the case of such roots springing from a monocotyledonous stem, the stem-system of pneumatophores could be separate from the root-system; but as the material for the present investigation did not include stem, it was not possible to test the continuity.

The foregoing considerations lead to the following conclusions:—

Aerial roots from several species of Palms are polystelic in their older thicker parts, and there is a continuous transition to normal monostelic structure in their younger thinner parts.

This difference in structure is due to a continuous change in the mode of differentiation of the apical meristem.

The whole structure of the older aerial parts is such as to fit them for withstanding both pressure as props or tension as stays; while the thinner subterranean parts are normal in conformity with the normality of their functions and environment.

In correlation with the bulk of these roots, and the absence from them of pneumatodes, there is a conspicuous formation of pneumatophores.

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EXPLANATION OF THE PLATES.

end., endodermis ; *i.sp.*, intercellular space ; *i.str.*, isolated strand ; *p.*, phloem ; *l.r.*, lateral root ; *scl.*, sclerenchyma ; *st.*, a complete stele ; *v.*, vessel of the wood.

Plate XIX.

Figs. 1–6. Diagrams illustrating various types of transverse section of *Areca* roots ; these types are distinguished merely for convenience, as there is perfect continuity of transition. The lines *end.* represent the endodermis, and with the aid of figs. 7–9 give an indication of the general disposition of the vascular system. $\times 1\frac{1}{2}$ diam.

Fig. 1. From a transverse section of a normal subterranean root of *Areca*, showing continuous endodermis and concentrated vascular cylinder.

Figs. 2–5. From sections of the same, somewhat tapering, aerial root of *Areca*. The arrows indicate corresponding points.

Fig. 2. From a section 15 millim. from the apex ; the vascular cylinder is more bulky, and relatively nearer the periphery than in fig. 1 ; the endodermis is almost circular in outline and is continuous.

Fig. 3. From a section 77 millim. from the apex ; the outline of the endodermis is markedly not circular and is discontinuous at several places ; it is, however, continuous at the point indicated by the arrow ↑ (see figs. 7 & 10).

Fig. 4. From a section 115 millim. from the apex ; the endodermis is more markedly abnormal in outline and more discontinuous ; at the point indicated by the arrow, the endodermis is almost discontinuous (see figs. 8 & 11).

Fig. 5. From a section 150 millim. from the apex ; the endodermis shows even more marked abnormality in outline and greater discontinuity ; it is quite discontinuous at the point indicated by the arrow (see figs. 9 & 12).

Fig. 6. Diagram of a transverse section of a thicker aerial root of *Areca*, showing greater complexity of structure ; a small complete stele (*st.*) is indicated by the continuous endodermal outline. This stele is drawn in greater detail in fig. 13.

Figs. 7–9. Diagrams to illustrate the disposition of tissues in the neighbourhood of the points indicated by the arrows in diagrams 3–5 respectively ; xylem and sclerenchyma are shaded dark ; phloem and parenchyma, light ; large vessels of the wood are shown unshaded and with double contour-lines ; large intercellular spaces, unshaded and with broken contours ; endodermis is represented by dark lines ; *i.st.* is an isolated strand traversing the pith. $\times 25$ diam.

Figs. 10–12. Drawings illustrating in greater detail the tissues in the neighbourhood indicated by the arrow in figs. 3 and 7, 4 and 8, 5 and 9 respectively ; dots in cells indicate that they belong to endodermis. $\times 200$ diam.

Fig. 10 shows the endodermis continuous ; the cells are young, and their walls not much thickened.

Fig. 11 shows the endodermis merging into sclerenchyma and almost discontinuous.

Fig. 12 shows the endodermis quite discontinuous.

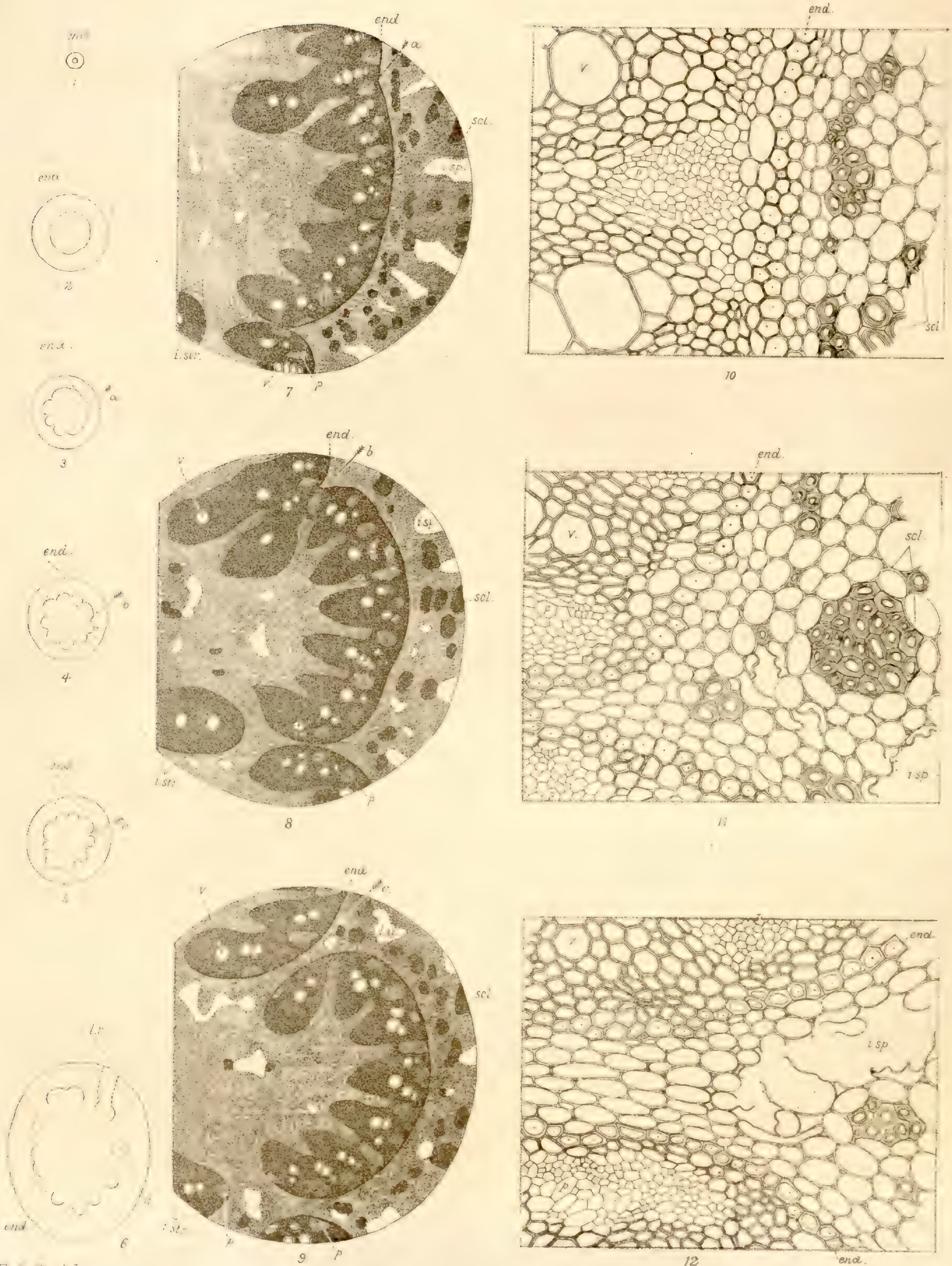
PLATE XX.

Fig. 13. Drawing from a transverse section of the small stele (*st.*) indicated in fig. 6; the cells of the endodermis are shown in their relation to the neighbouring cells of the cortex and of the pericycle; other features are indicated as in fig. 7. ×100 diam.

(In the absence of an objective possessing simultaneously field and magnification sufficiently great, this figure was obtained thus: a set of camera-lucida drawings was made under a magnification of 294 diameters; these sections were then accurately fitted together; a tracing was then made and the whole revised; that drawing has been reduced by the lithographer to a magnification of 100 diameters.)

Fig. 14. Diagram representing a transverse section of a thick root of *Verschaffeltia*; many incomplete and several complete steles are indicated; the complete stele (*st.*) is the one shown in fig. 15; large vessels of the wood are indicated by small circles. ×2 diam. (The drawing was checked by observations under a magnification of about 60 diameters.)

Fig. 15. Diagram to illustrate the disposition of tissues forming the stele (*st.*) in fig. 14; scheme of shading and lettering as in fig. 7. ×25 diam.



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POLYSTELIC ROOTS OF PALMS.

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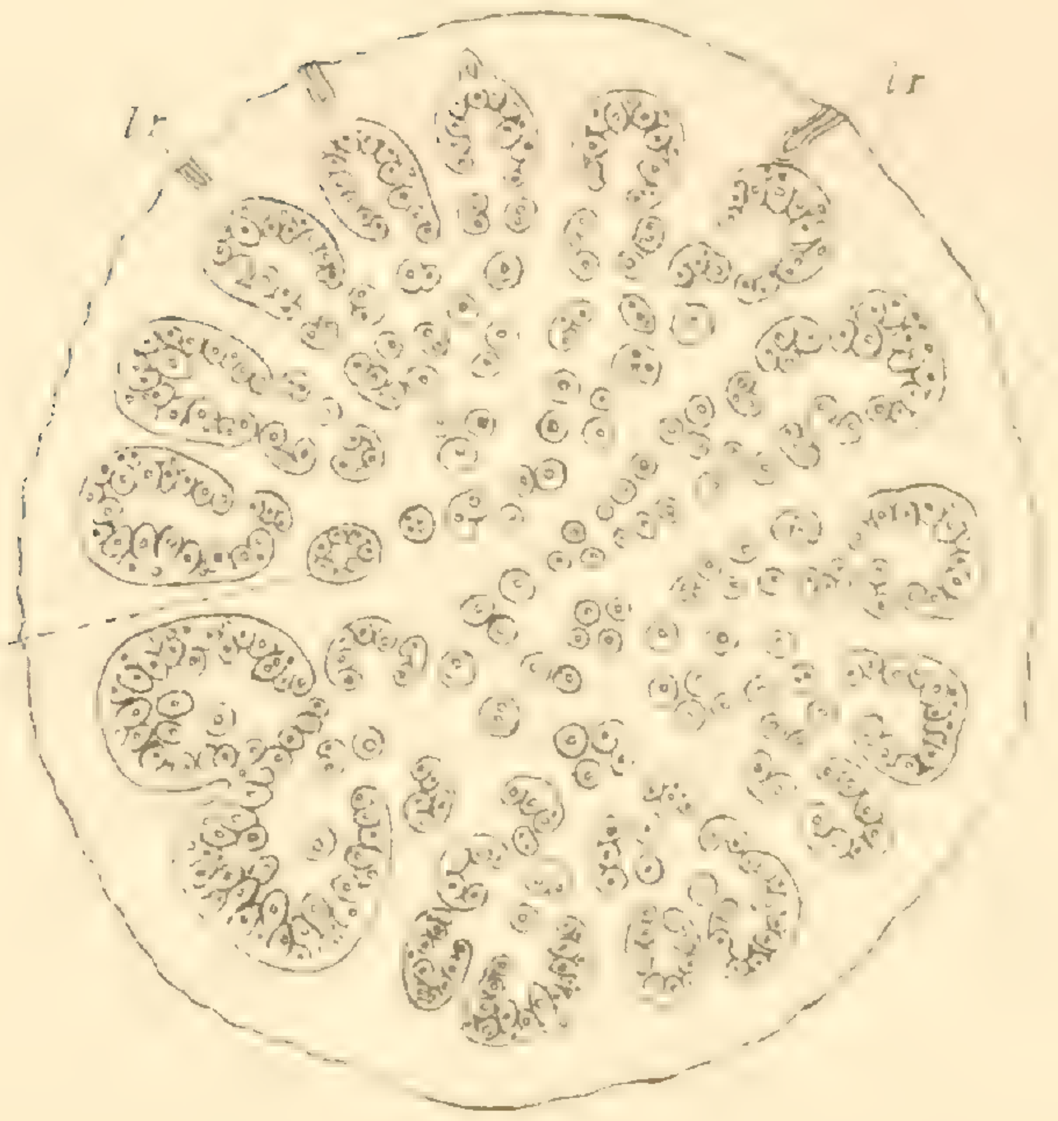

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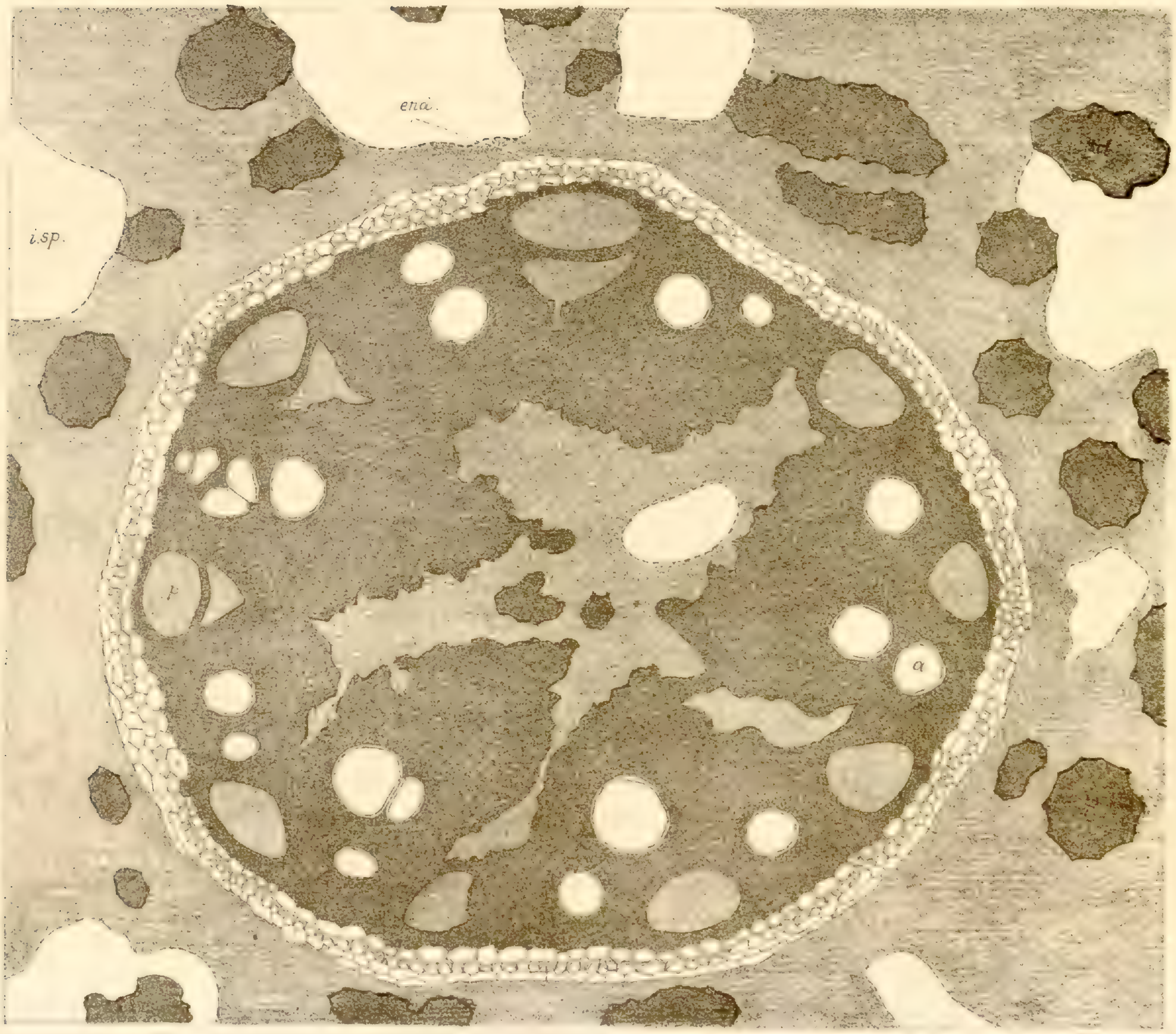

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POLYSTELIC ROOTS OF PALMS.

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ON SOME POINTS IN THE MORPHOLOGY AND ANATOMY OF THE NYMPHÆACEÆ.

BY

D. T. GWYNNE-VAUGHAN, B.A. CANTAB.

(*Communicated by* D. H. SCOTT, Ph.D., F.R.S., F.L.S., &c.)

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October 1897.

VII. *On some Points in the Morphology and Anatomy of the* Nymphæaceæ. *By* D. T. Gwynne-Vaughan, *B.A. Cantab.* (*Communicated by* D. H. Scott, *F.R.S., F.L.S., Hon. Keeper of the Jodrell Laboratory, Royal Gardens, Kew.*)

(Plates XXI. & XXII.)

Read 18th February, 1897.

Morphology of the Leaf.

Some time ago the rhizome of a mature plant of *Victoria regia* and also a number of young seedlings of the same which had been grown in the Royal Gardens, Kew, were placed in my hands; and I spent some time under the direction of Dr. Scott, for whose valuable advice and supervision throughout I have every reason to be grateful, in examining the material thus placed at my disposal. In the course of this examination various points of such interest came into view as to lead to the investigation of other plants of the same order for the sake of comparison. Some of the results obtained thereby I have ventured to detail in this paper.

In dissecting away the growing-point of the mature rhizome some of the earliest stages of the adult leaves were disclosed, and since I have not met with any figures of the well-known leaf in its young state, three of them are represented on an enlarged scale in Pl. XXI. figs. 1, 2, & 3.

The smallest leaf figured is about 1·5 mm. long; and here it may be seen that the rudimentary lamina stands erect and broadly based on a short, stout support, the future petiole, the extension of the lamina below the point of insertion being much less than the extension above it. So the petiole is inserted excentrically, and the general outline of the lamina is ovate and not orbicular. The sides of the lamina are raised up like those of a bowl, the edges being rounded off owing to the fact that they are slightly curled inwards, although the involute prefoliation which is a characteristic of the young leaf in its later stages is not nearly so prominent in the earlier ones.

The apex tapers to a blunt point slightly incurved, and differing but little, if at all, in texture or appearance from the rest of the leaf—quite otherwise than what might be expected from the case of *Euryale ferox.* Judging from a plate of that plant given in the 'Flore des Serres et des Jardins de l'Europe,' illustrating a description written by Planchon, the general appearance of an early stage of an adult leaf is closely similar to that described for *Victoria regia*; on the other hand, the apex takes the form of a broad terminal lobe folded over on to the ventral surface like a hood, being almost free from prickles, and not partaking in the involution of the rest of the leaf.

In view of the suggestion put forward by Baillon with regard to the differentiation of the pitchers of *Sarracenia, Nepenthes,* &c., that they were derived by an extreme

exaggeration of the peltation of such a bowl-shaped peltate lamina as that of *Nelumbium*, the operculum representing a portion of the lamina unaffected by the peltation, this hood or terminal lobe of the young *Euryale* leaf might well be compared with the operculum of a pitcher. The great similarity between the early development of the pitchers and of peltate leaves, such as those of *Victoria* and *Nelumbium*, also tends to show that a comparison between the two is not altogether fanciful.

The methods of origin of a pitcher on the one hand, and of a peltate lamina on the other, as respectively described by Bower * and Trécul † are fundamentally identical. The first indication of each is the appearance of a shallow depression on the adaxial side of the leaf-rudiment, just below its apex; which depression is caused by the slow growth of a central area relative to that of the regions surrounding it. A single point of difference is that in *Nelumbium* the growth of the region at the base across the summit of the petiole is for a time delayed, so that, to begin with, the central depression is but incompletely surrounded by a horseshoe-shaped emergence instead of a complete annular cushion. However, the delayed region soon takes up a more rapid growth, joining the two arms of the horseshoe transversely across the summit of the petiole; then the whole grows out into the peltate lamina.

Prof. Bower has shown (*l. c.*) that the operculum of the pitcher is at first a two-lobed structure, which he regards as representing two pinnæ congenitally coalescent across the adaxial surface of the leaf. It is known that in certain peltate leaves, as in *Hydrocotyle vulgaris* ‡ and in *Tropæolum majus* (Trécul, *l. c.*), the earlier stages are seen to be very distinctly lobed with a terminal unpaired lobe. With this fact in view, it becomes easy to suppose that in the pitchers, themselves originating in a lobed leaf-rudiment, the upper pair of lobes may remain free from the peltation of the rest of the leaf, to form an operculum in the manner described by Prof. Bower, while the terminal lobe grows out into the spur found at the point of the insertion of the operculum on to the pitcher on the dorsal side.

The prickles and spines which beset the under surface of the adult leaves of *Victoria regia* are also clearly visible on young leaves which have attained a length of about 5 mm. Before that size is reached, although the petiole and the lamina with its principal veins are already clearly developed, the prickles are not yet visible. They first make their appearance as little rounded projections on or near the midrib, at the points where the lateral veins join on to it, the midrib being at this stage by far the principal vein in the leaf. Most of the larger prickles are traversed by a narrow strand of vascular tissue, and they are said by Trécul § to terminate in a "pore" or "ostiole" which opens below into a small cavity. My observations, however, entirely confirm those of Mr. Blake (Ann. Bot., i. p. 74), who failed to find any trace of this pore. I noticed, however, that if the tip of one of these prickles be viewed directly from above, the rounded terminations of a number of cells which are arranged in a ring around a central one give an appearance

* Ann. of Bot., vol. iii. p. 239.

† Ann. des Sc. Nat., sér. 3, vol. xx. p. 261.

‡ Goebel, Schenk's 'Handbuch der Bot.,' Band iii. 1ste Hälfte, p. 234.

§ Ann. des Sc. Nat., sér. 4, tom. i. p. 156.

not unlike that figured by Trécul; and in the absence of any sections of the prickle may have led him to look upon it as bearing an actual pore.

Van Tieghem considers the prickles to be homologous with those on the surface of the leaves of certain varieties of *Ilex Aquifolium*, or with the tentacles of *Drosera*.

The method of growth of the leaves of *Victoria regia* has been fully described by Planchon in his monograph on this plant, although he gives no figures attached.

At the base of each mature leaf on its ventral side there lies a membranous scale, curving away from the leaf to which it belongs, and sheathing all the younger structures in the bud (Pl. XXI. fig. 4). It is formed by the fusion of two stipules along their inner margins on the adaxial side of the leaf. The first or first two leaves of the seedling have no such axillary scale, but their bases are slightly winged by two small lateral appendages, which probably represent the free lateral stipules found in certain Nymphæas, *N. zanzibariensis* &c. (fig. 5). The intrafoliar scale of *Nelumbium* is probably derived in the same way as that of *Victoria*.

The embryonic leaves of the seedling are quite different in appearance from the adult leaves of the mature plant, and they show, by an interesting series of gradations, a progressive change from an acicular primordial leaf (or petiole only, according to Trécul) to the peltate form of the mature plant. The exact form of corresponding leaves in different seedlings varies considerably. However, the first leaf is always found to be acicular. The second possesses a lamina, usually elongate-lanceolate, sometimes with two small hastate lobes at the base. The third (fig. 6) varies from elongate-hastate to deltoid-hastate, the auricles are widely divergent, and at the base of the lamina, just above the insertion of the petiole, there is invariably a little pocket or pouch on its adaxial side, which appears to have been formed by the fusion of the auricles at their bases across the adaxial surface of the leaf. The fourth (figs. 7 & 8) is the first that bears spines, and that shows itself to be distinctly peltate. It is the first swimming leaf, and has a lamina oval in outline with a subacute apex; there are two auricles at the base which do not diverge, but lie more or less close together, thus making the leaf sagittate. The fusion between them at their bases is here carried much further than in the previous leaf; in fact, they are fused together for about a third of their whole length from the point of insertion of the petiole, the line of fusion being followed by a small vein. So the final form attained by this leaf closely resembles that of the adult leaves of many Nymphæas, *N. Lotus*, *gracilis*, *delicatissima*, &c., in which the fusion of the auricles is never carried any further. In *Victoria regia*, on the other hand, the succeeding leaves become more and more orbicular in outline, and the auricles become fused along a successively greater part of their length until the final form of the adult leaf is attained.

As previously stated, the leaf of the mature plant owes its peltation to the formation of a zone of growth across the summit of the petiole on the adaxial surface of the leaf, which by its activity forms a mass of tissue joining together two parts of the lamina previously separate and distinct. Hence it would appear that the leaf of the mature plant passes in its youth through stages which are quite parallel to those permanently retained by the embryonic leaves. Thus, the third leaf of the embryo may be regarded

as the first in which the transverse zone appears at all; its activity being as yet but little marked, the structure arising from it is correspondingly minute. Whereas in the fourth and succeeding leaves the duration of its activity and the results obtained thereby become more and more considerable. So, in this case at least, it may be said that the ontogeny, if it may be so termed, of a single leaf of the mature plant repeats, in some degree at any rate, the true ontogeny of the leaves of the plant as a whole—that is to say, it repeats the developmental stages of the embryo.

The embryonic leaves of *Nymphæa* and *Nuphar* pass through a series of stages somewhat similar to those of *Victoria* until a more or less sagittate form is reached. In many species no further advance is made, the auricles remaining practically free throughout (*Nymphæa pygmæa*, *N. stellata*). In others (those mentioned above) they fuse together to about the same extent as they do in the fourth leaf of *Victoria*.

The adult leaves of *Barclaya* show a still simpler form, being elongate, strap-shaped, and slightly auricled. After consideration of the above gradations they might perhaps be held as approximating to the ancestral leaves of the *Nymphæaceæ* in their form.

With regard to its embryonic leaves, *Nelumbium* signalizes its distinction from the other *Nymphæaceæ* by the fact that the first leaf is not acicular, but it and the succeeding leaves closely resemble in miniature those of the mature plant.

Anatomy of the Mature Rhizome.

The chief feature in the structure of the rhizomes of the *Nymphæaceæ* is the astelic arrangement of their vascular bundles, and in most cases a second very prominent characteristic is occasioned by the almost indescribable confusion and complexity presented by these bundles in consequence of the exceedingly irregular courses they pursue and the intricate anastomoses they undergo. This complexity is found at its maximum in the rhizomes of *Victoria* and *Nymphæa*. The vascular bundles are for the most part massed together in the central region of the rhizome, where they run indiscriminately in all directions and without any attempt at order, the utmost diversity also being exhibited in their orientation. On the outside of this central region there lies a belt of continuous parenchyma comparatively free from vascular bundles, traversed only by those passing outwards from the central mass towards the exterior. Another narrow zone of tissue of exactly the same nature lies immediately below the surface of the rhizome. Finally, between these two there is a broad belt of "cavernous tissue" (*cf.* Henfrey, Phil. Trans., 1852, pp. 289–294). The latter is formed by a number of large lacunæ filled up with spongy masses of very loosely packed cells, and separated from each other by supporting plates or laminæ of continuous tissue connected on either side with the previously mentioned zones of firm parenchyma.

Those species in which the rhizomes remain throughout comparatively small, such as *Nymphæa flava*, show, in accordance with the diminution in the number of bundles present, a corresponding decrease in the complexity of their arrangement. Further, in this species and in *N. tuberosa* it is noticeable that almost all the inner bundles are oriented in the same direction, *i. e.* inversely; many of them having their xylems confluent with those of the outer normally oriented bundles. Differences are in

particular to be observed in the sharpness of the delimitation between the central vascular region and that surrounding it, although in no case is any appearance presented that might be regarded as a central cylinder. This distinction is least apparent in the Nymphæas, indeed it is scarcely to be observed at all in *N. alba* and *N. blanda*; whereas in *Victoria regia* it is very clearly defined, owing to the fact that the vascular elements at the periphery of the central mass constantly run in certain definite directions, forming thus a zone continuous but for interruptions due to the outward passage of traces to the leaves &c. The outer components of this peripheral zone are found to be groups of phloem elements running around the central region in obliquely horizontal directions, like so many hoops or girdles. Next within come a number of more or less separate vascular bundles (or sometimes groups of tracheides only), the elements of which run almost vertically. Finally, there is often another inmost system of tracheides running almost horizontally, although this last is frequently absent.

The rhizomes of the Nuphars differ from those of the Nymphæas, and from that of *Victoria regia*, principally in the absence of that "cavernous zone" described above. On the contrary, the ground-tissue is homogeneous throughout, and consists of a spongy lacunar parenchyma with large intercellular spaces which decrease in size as the periphery is approached. Again, the vascular bundles are not so confused; a greater proportion of them run vertically, especially in the peripheral regions, where certain of them are arranged in a very irregular ring, on the outside of which the ground-tissue is traversed by the small leaf-traces only. Most of the vascular bundles have their xylems turned towards the centre, although some are turned in various other directions. Some again run singly and separately in the ground-tissue, but the majority are fused together by their confluent xylems into groups of from two to four. These groups are due to the fact that the bundles in the course of their anastomosis very often run together and very closely applied to each other for some time before separating again.

In *Cabomba aquatica*, whether in the comparatively short internodes of the sympodial rhizome or in the elongated ones of the floating shoots, the structure, on account of its great simplicity, is very different in appearance from that described in the above genera. There are only two pairs of bundles present. In the rhizome the bundles of each pair are situated almost exactly facing each other; in the floating shoot each is placed along one arm of a V, the apex of which is occupied by a canal representing the disintegrated xylems of the pair. At every node a leaf-trace arises from each pair, being formed by the fusing together of two branches, one from each of the components of the pair. At the same time the two bundles of each pair separate and travel horizontally round the stem in opposite directions to meet the corresponding bundles from the other pair, with which they fuse to form the two pairs for the next internode.

With regard to *Nelumbium speciosum*, the rhizome possesses, in its elongated internodes, a large number of vascular bundles arranged in several concentric circles and running quite vertically. They are all directly oriented, except the members of the third and fifth inmost circles, which are all inverse. In the outer circles the bundles are undoubtedly free and separate from each other, but the twelve which form the inmost rings of all are held by Van Tieghem to constitute a central cylinder surrounded by a

common endodermis *, although this could not be decided from the young seedlings examined by me. In the nodal regions, which, according to Trécul †, represent four successive nodes with their internodes contracted to obliteration, the bundles of the two inmost circles branch and anastomose in an extremely complicated manner, as has been described by Wigand in the 'Bibliotheca Botanica,' vol. ii. Heft 11.

It seems to me possible that the intense complexity of the arrangement of the bundles in *Victoria*, *Nymphæa*, and *Nuphar* may have been derived from a simpler structure previously existent in a stem with longer internodes, as a result of the contraction and elimination of these internodes in consequence of the adoption by the stem of a rhizomic habit.

Anatomy of the Seedling.

The arrangement of the vascular tissue in the young seedling of *Victoria regia* is, on the whole, very similar to that in the mature rhizome, but the limiting zone of the central mass is more prominent, and is separated off from the irregular bundles lying within it in a much more decided manner, because the position of the inmost system of horizontal tracheides which are usually present in the mature rhizome is here occupied by a corresponding belt of parenchymatous cells. It becomes quite clear in the seedling that the bundles which supply the leaf-traces are derived from the internal vascular mass, whereas those which eventually supply the roots are derived from the limiting peripheral zone. Passing further down still in the seedling stem the central mass decreases steadily in size, particularly with regard to its internal irregular constituents, so that the bundles of the peripheral zone become relatively more conspicuous still. Nevertheless these also decrease in number until a point near the insertion of the first leaf is reached where only four of them remain. At this point also only a few of the tracheides of the internal vascular tissue persist. Finally the four peripheral bundles unite to form two, which are placed in the epicotyl exactly opposite one another, so that their xylems are confluent in the centre with the remains of the internal tracheides, if, indeed, any of these are still present. Stating these facts from another point of view, it may be said that the transition from the narrow epicotyledonary stele to the structure found in the mature stem takes place in *Victoria* in a manner quite similar to the same proceeding in an ordinary monostelic plant. The bundles of the epicotyledonary stele subdivide so as to form a number arranged in a ring around a central pith. So, for some time at any rate, the young seedling is undoubtedly monostelic, having a single central cylinder with a common endodermis surrounding it; the presence of the latter being, under suitable treatment, clearly demonstrable even so far up as the fourth leaf. But in *Victoria regia*, above the insertion of the first leaf, this central cylinder at the same time undergoes great modifications from the appearance in the medulla of an ever-increasing amount of vascular tissue. Concurrently with this the central cylinder itself becomes more and more expanded, irregular, and broken up, until in the mature rhizome its limits are quite unrecognizable as such.

* Bull. Soc. Bot. de Fr., vol. xxxiii. p. 75.

† Ann. des Sc. Nat., sér. 4, tom. i. p. 296.

The seedling of *Nymphæa zanzibariensis* also is at first monostelic, and for about the same distance upwards as in *Victoria regia*, but the transition from the stele of the epicotyl into that of the internode immediately above takes place in a different manner. The epicotyledonary stele is exactly similar to that of *Victoria*, and the two bundles which it contains as they pass upwards increase in size and subdivide; however, the several bundles thus formed do not separate from one another, but remain with their xylems confluent. Hence, although there is for a time a single central cylinder with a common endodermis, the bundles do not become distinct and arranged in a ring around a medullary region as they do in *Victoria*. Therefore the central cylinder must always be very slender, and any further extension to meet the increase in diameter of the stem has to be provided for by a complete separation of the bundles. This will also account for the absence of a peripheral zone around the central vascular mass in the mature rhizome of this genus.

The structure of the seedling of *Nelumbium speciosum* is widely different from those of *Victoria* and *Nymphæa*, and is particularly remarkable for the large number of vascular bundles exhibited in the epicotyledonary internode. There are some 20–30 of them arranged in concentric circles, much as in the internodes of the mature rhizome, from which the chief differences are, that in the epicotyl the bundles are fewer, and that the two circles of inverse bundles are absent. The second internodal region has a structure almost identical with that of the mature rhizome.

It is a remarkable fact that in the seedling of *Nelumbium* an almost complete absence of primitive features is met with both in the leaves and in the stem. Moreover, the primary root is completely abortive and never escapes from the seed-coat. The precocity with which this plant assumes its definitive form stands in strong contrast to the gradually progressive stages exhibited by the other members of the order.

Apical Meristem.

I have not been able to obtain preparations of the apex of a mature plant of *Victoria regia*, but microtome series of that of *Nymphæa tuberosa*, prepared by Dr. Scott, show clearly that the apical cone is entirely composed of a number of homogeneous meristematic cells, no desmogen strands appearing therein until considerably lower down, where they are developed in an entirely indiscriminate manner. Nothing resembling a plerome is at any time to be discovered. I have also found a very similar state of affairs in *Cabomba aquatica*. The apex of the floating shoot has the form of a small rounded cone composed of rather large meristematic cells, among which no sort of differentiation is exhibited, until, at a point lower down, the procambial rudiments of the two vascular strands appear on opposite sides of the stem.

On the other hand, in the young seedlings of *Victoria regia* and of *Nymphæa zanzibariensis*, taken while yet barely out of their monostelic stage (Pl. XXI. fig. 9), the meristematic tissue of the apical cone itself is continued down into the stem as a central column or cylinder of very similar meristematic cells, in which, later on, desmogen strands make their appearance. In the case of the *Nymphæa* they are irregularly scattered throughout it; in *Victoria* those situated at the periphery seem to be the first developed.

So that, although there is no separation of plerome and periblem in the apical cone itself, a little lower down in the young stem such a distinction becomes evident.

Insertion of the Adventitious Roots.

In the several genera examined by me, and probably throughout the whole order, the rhizomes are beset with adventitious roots springing in clusters from the bases of the petioles. In *Nelumbium* they are present at the base of every leaf, so also, the first or acicular leaf excepted, in *Victoria*, *Nymphæa*, and *Nuphar*. The number of roots belonging to each cluster varies considerably, being greatest (15–20) in the mature rhizome of *Victoria* (Pl. XXI. fig. 10); on the other hand, in *Nymphæa* and *Nuphar* each group contains from 3 to 7 only.

These roots are given off from certain vascular bundles especially set aside for that sole purpose, which are separated off from the central vascular mass, and run apart from it in an upward direction in the outer region of the rhizome into the dorsally protuberant bases of the petioles, where they lie on the outer side of the leaf-traces (fig. 11).

That certain bundles were thus set aside for the express purpose of bearing the adventitious roots was observed by Trécul in *Nuphar luteum* in 1845 *, in *Victoria regia* by Henfrey in 1852 †, and in *Nelumbium speciosum* by Wigand in 1871 ‡. I have further discovered that the different species show interesting variations in the manner in which these bundles are arranged. For instance, in *Victoria regia* (fig. 12) all the root-bearing bundles belonging to the same leaf-base are grouped together so as to form a structure having the appearance of a definite and distinct stele, consisting of a number of vascular bundles, usually about 20, arranged in a complete ring, with the phloem groups well marked and generally distinct from each other, while the xylem elements form a more or less continuous ring within them. Other xylem elements are scattered throughout the central parenchyma of the stele, so that no definite medulla is distinguishable (fig. 13). The xylem is centrifugally developed, although, since it is entirely composed of long pointed tracheides, longitudinal sections are necessary to settle this point. The whole stele is surrounded by a clearly marked endodermis. This stele bears the adventitious roots in acropetal succession on its outer side, while it itself terminates in the youngest root or roots.

Owing to the delay in the further development of the adventitious roots after their first formation they possess pedicels of a considerable length, and do not obtain individual cortices until they have reached the extreme periphery of the leaf-base, where the point at which they do so is marked in each root by the presence of a hemispherical transverse diaphragm formed by a layer of small closely packed cells. These diaphragms enable the roots to be broken off the stem, leaving behind a clean-cut scar and not a tear. In appearance the pedicels resemble the structure of a stem stele much more than that of a root (fig. 14). They have a ring of several indistinct groups of phloem, and within this an almost continuous ring of xylem elements surrounding a small medulla; the whole

* Ann. des Sc. Nat., sér. 3, tome i. p. 293 *et seq.*

† Phil. Trans. 1852, p. 289 *et seq.*

‡ Botanische Zeitung, No. 48, p. 821.

appearing perfectly collateral. However, at the point where the root first obtains its individual cortex, groups of small xylem elements are seen lying *between* the phloems, and at the same time the xylem *underlying* the phloems disappears, so that at this point the typical root-cylinder is established. In *Nymphæa*, where the roots are fewer to each cluster, the root-bearing stele is smaller and more irregular than in *Victoria*, it is also considerably shorter. It runs at first almost horizontally outwards, and does not turn upwards until it has given off the first, *i. e.* lowest root. The pedicels here attain the appearance of a normal root cylinder shortly after they leave the root-bearing stele and before they possess individual cortices. In perfection of structure the stele formed by the root-bearing bundles varies with the species. Thus, in *Nymphæa alba* and *N. tuberosa* the 10–12 vascular bundles are arranged throughout their course in a complete and well-formed stele, essentially similar in all points to that of *Victoria regia*. In *N. flava* the stele is much smaller, containing about 6 or 7 bundles only, and it is at the same time to a certain extent incomplete, for the phloem groups are very scanty or altogether wanting on the inner side, especially in the lower portion of the stele. In *N. blanda* a stele, as such, can scarcely be said to exist at all, the several root-bearing bundles pass out from the central mass distinct and separate from each other. They become arranged in a semicircle, and later fuse up laterally to form a continuous arc, finally to form a more or less imperfect stele as in *N. flava*. In this respect *Nymphæa blanda* makes a close approach to the condition observed in the Nuphars (*N. advena* and *N. luteum*), where the root-bearing bundles, some 10 in number, also pass out from the central vascular mass separately, and very soon fuse together into an irregular band or arc of greater or less curvature, sometimes almost a complete circle. A segment of this arc becomes separated off to supply the first or lowest root; the ends of this smaller arc immediately grow round to meet each other, and form thus a complete ring, so that the pedicel has at its base the strange appearance of a ring of vascular bundles surrounding a pseudomedullary mass of ground-tissue with both an external and an internal endodermis. This structure is retained even after the vascular bundles have taken up the radial arrangement typical for a root stele, which they do long before the root attains a cortex of its own. As the pedicel contracts to form the narrower cylinder of the root itself, the pseudomedullary tissue and the internal endodermis gradually disappear. After the departure of a root the remaining portions of the arc of root-bearing bundles either fuse up again as before, or form separate groups until the next root is to be given off, when the same proceeding is repeated.

In *Cabomba* and *Nelumbium* the rhizomes bear adventitious roots in the same manner at the nodal regions on special steles, which pass directly outwards, but only reach a short distance before they break up into an umbel of roots all springing from about the same point.

In *Cabomba aquatica* it appears that only the sympodial rhizome bears roots: the floating shoots bear no roots at all. The comparatively stout stele is very short, and consists of a mass of xylem elements scattered in the central conjunctive tissue, and surrounded by a narrow ring of phloem, in which separate bundles can hardly be distinguished.

The Occurrence of Polystely.

During the progress of these investigations my attention was directed by the Curator of the Gardens, Mr. Watson, to certain remarkably elongated stolons or runners borne laterally on the rhizomes of *Nymphæa flava.* They are found below the surface of the soil, and are evidently produced in order to ensure the survival of the plant through those seasons of the year which are unfavourable to its continued growth, and at the same time to increase the number of individuals. Similar functions are performed by the laterally produced tubers in *Nymphæa tuberosa.*

The stolons of *N. flava* attain a considerable length (30–40 cm.), and are slightly thickened at their terminations, where they bear a number of short tuberous starch-laden roots on their under surface, and on their upper surface a number of buds protected by scale-leaves (Pl. XXII. fig. 15). In these stolons the vascular bundles are arranged in 4–5 widely separated groups lying in a uniformly lacunar ground-tissue, with a rather abruptly marked off hypodermal zone of continuous parenchyma (fig. 16). Each group consists of 3–4 vascular bundles arranged around a central canal which has taken the place of their disintegrated protoxylems, the remains of which are still to be seen at the borders of the lacuna. The phloem groups, on the other hand, are well developed and very prominent; seen in transverse section they are ovate in outline and quite distinct from each other. In greater part they are composed of sieve-tubes of exceptionally large lumen accompanied by their companion cells, while on the outside there is a small cap of phloem parenchyma. Only a few of the later formed elements of the xylem are persistent on the inner side of the phloem groups; they are separated by several parenchymatous cells from the central canal. At either end of the runner this xylem is considerably increased in amount, and its elements fill up the space elsewhere occupied by the canal. A beautifully-marked endodermis surrounds each group completely; so that each of them exhibits in itself all the essentials of a complete stele (fig. 17). It is curious to note that in the cells of the endodermis the fold on the radial walls is rarely placed exactly in the centre, but is nearly always situated nearer to the inner tangential wall than to the outer—an idiosyncrasy which is also a characteristic of the polystelic Primulas and Gunneras. Approaching the termination of the runner where the buds and tuberous roots are borne, the ground-tissue becomes continuous throughout, the lacunæ disappearing; the bundles in each stele become confused and indistinct; and at certain intervals, in relation to the insertion of the buds, the steles themselves fuse up into an irregular circle, beyond which they scarcely regain their identity before they enter into another similar fusion, and so on.

In *N. tuberosa* the stalks which bear the tubers are very short, not more than 4 cm. long, some of the tubers being almost sessile. Their structure in all cases examined is essentially similar to that of the runners of *N. flava*, 3–5 separate steles being present, each composed of 3–5 vascular bundles, although here the ground-tissue is without lacunæ, and the bundles within each stele are less distinctly separated from one another. The whole structure is, in fact, closely comparable to that of the runners of *N. flava* near their tuberous bud-bearing extremities.

In all cases where tubers are produced in the *Nymphæaceæ* the first or first two internodes of the new growth resulting from their germination develop into thin stolons, in *Nymphæa flava* about 5 cm. long, which swell out at their extremities to form new rhizomes (Pl. XXII. fig. 18). And it is a very remarkable fact that the first leaves borne on these rhizomes are submerged ones, entirely similar to the embryonic leaves of the young seedling, except that the very first leaf of all is not truly acicular, but possesses a very small lamina.

When these new growths arise from buds upon a primary runner or stolon, as in *N. flava*, they may be called secondary stolons. They contain 4–7 vascular bundles (in fig. 19, 4 only), and the exact manner in which they are arranged varies from one stolon to another, and even in the different regions of the same stolon; thus, a varying number of them may be united in pairs, or they may be all separate and distinct. In fig. 19 there are two separate bundles, and two fused to form a pair. Sometimes six bundles are present, and these are fused together so as to form two pairs; then the resemblance that such a section bears to one of the floral peduncles of *Cabomba aquatica* is most remarkable, for here also there are six bundles almost identical in appearance, and also united into three pairs. The vascular bundles of the secondary stolon are exactly similar to those described in the primary. The phloem groups are very prominent, with an outer cap of phloem parenchyma, within this a mass of large sieve-tubes with their companion cells, and then a few small xylem elements at their inmost points, the position of the earlier-formed elements being as before occupied by a canal formed by their disintegration; and finally each bundle or pair of bundles is surrounded by a very clear endodermis. As the runner approaches its termination, where it becomes converted into the new rhizome, it increases very much in girth, the internodes between the first leaves, which are borne at this point, being very short and thick. The vascular bundles, whether single or in pairs, increase in size, lose their regularity, and fuse laterally with each other. At the same time they subdivide so as to form so many groups of bundles which partially recover their identity after each node, although less and less distinctly as you pass higher up in the stem, until at last the usual structure of the rhizome is attained.

It is especially to be observed in some species that those rhizomes which take their origin in this manner from such secondary stolons have their vascular bundles, throughout the whole rhizome, more or less gathered into groups around different centres, generally three, forming groups which correspond to those found at the base. All the bundles in each group direct their xylems towards the point around which they are arranged; and so it comes to pass that in these rhizomes the inner bundles of the vascular mass are, for the most part, inversely oriented, which point has been previously referred to.

A similar grouping is seen in the tubers of *N. tuberosa*, which are borne on the polystelic stalks mentioned above.

Summary.

We see, therefore, that the plants in this Order, although generally astelic, sometimes aggregate all the vascular bundles present in certain of their members into so many steles, or, it may be, that only those bundles which are set apart for a certain function are thus dealt with, although they may be lying in a region of the plant otherwise astelic.

These steles vary greatly in compactness, size, and particularly in the number of bundles which assist in their formation. From the large many-bundled root-bearing steles of *Victoria regia*, through the smaller ones of about a dozen bundles of *Nymphæa alba* and *N. tuberosa*, we pass to the steles containing four to three only in the primary stolon of *N. flava*, and finally to those containing two bundles in the secondary stolons of the same plant and throughout the whole structure of *Cabomba* and *Brasenia*—if, indeed, we are entitled to call the latter steles at all. In relation to this point the close similarity that these paired bundles show in all points of structure to the pair of bundles found in the cylinder of the epicotyl of *Victoria* and *Nymphæa* should be borne in mind, and the latter, in virtue of its position, must be acknowledged as a diarch stele. Moreover, there are many other admitted steles which consist of two bundles only in the stems and petioles of many Ferns and Selaginellas. If this question be answered in the affirmative, *Cabomba* and *Brasenia* must no longer be described as astelic, but as essentially polystelic. However, the exact manner in which the two pairs arise from the central cylinder of the epicotyl should first be determined before any final decision is arrived at.

Finally it may be remarked that the simplicity of the anatomical structure in *Cabomba* and *Brasenia* is completely in accordance with the structure of their flowers, the want of complexity in which also distinguishes these plants from the rest of the Order—the parts of the flower being arranged in whorls of three only, and the gynæcium being superior and apocarpous.

EXPLANATION OF THE PLATES.

Plate XXI.

Figs. 1–4. Young stages of mature leaves of *Victoria regia*. 1. Very young, front view (×10). 2. Older, back view (×8). 3. Still older, side view (×8). 4. Young leaf, *in situ*, seen from behind, and showing axillary scale, which curves away from the leaf (× about 2).

Fig. 5. Young stage of mature leaf of *Nymphæa zanzibariensis*, showing the free lateral stipules (×4).

Figs. 6–8. Embryonic leaves of *Victoria regia* seedling (nat. size). 6. 3rd leaf showing the "pocket" of the lamina at the insertion of the petiole. 7. 4th leaf, front view. 8. 4th leaf, back view.

Fig. 9. Median longitudinal section of apical region of young seedling of *Nymphæa zanzibariensis*: *lt.*, leaf-trace; *rt.*, root-bearing stele; *vv.*, desmogen strands in central meristematic cylinder (×240).

Figs. 10–11. Base of petiole of mature leaf of *Victoria regia* (nat. size). 10. In surface view, showing position of adventitious roots. 11. In section: *rt.*, root-bearing stele; *p.*, pedicels; *l.*, air-canals in the petiole.

Fig. 12. Transverse section of the root-bearing stele of same plant (×80): *x.*, xylem; *ph.*, phloem; *e.*, endodermis.

Fig. 13. Portion of such a stele, more highly magnified (×225).

Plate XXII.

Fig. 14. Transverse section of the pedicel of an adventitious root of *Victoria regia* taken near its point of origin from the root-bearing stele (×155).

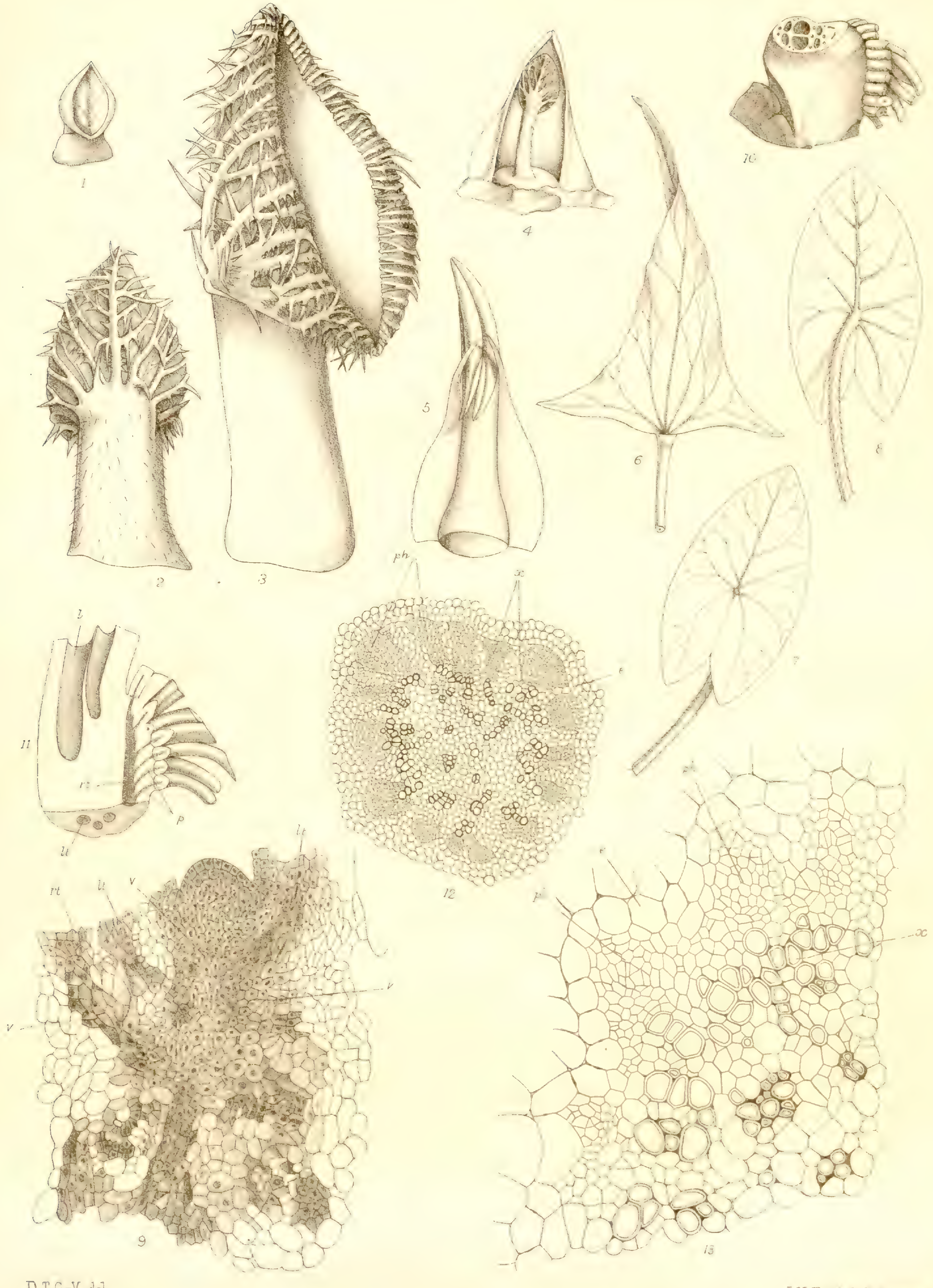
Fig. 15. Plant of *Nymphæa flava* ($\frac{2}{3}$ nat. size): *st.*, primary stolon, bearing buds, *b.*, and tuberous roots, *r.* The stolon becomes slightly tuberous during its course at point *p.*; *l.*, leaf-scars on rhizome.

Fig. 16. Transverse section of the primary stolon of the same plant, showing four steles, two with four bundles each, and two with three only (×25).

Fig. 17. Stele of the same, more highly magnified (×150): *x.*, persistent xylem-elements; *st.*, sieve-tubes; *p.*, phloem parenchyma; *e.*, endodermis; *l.*, central canal with remains of protoxylem; *h.*, stellate hair.

Fig. 18. Thickened extremity of primary stolon (slightly enlarged): *pr.st.*, primary stolon; *b.*, buds on the same. The oldest has grown out into the secondary stolon, *sc.st.* The latter thickens above to form the new rhizome, *rz.* $l.^1$, 1st leaf of new rhizome, $l.^2$, the second, $l.^3$, the third: *r.*, tuberous roots.

Fig. 19. Transverse section of secondary stolon (×30). Four vascular bundles present: *a* is a single separate one; *b* has been formed by the complete fusion of the two bundles of such a pair as that at *c*.



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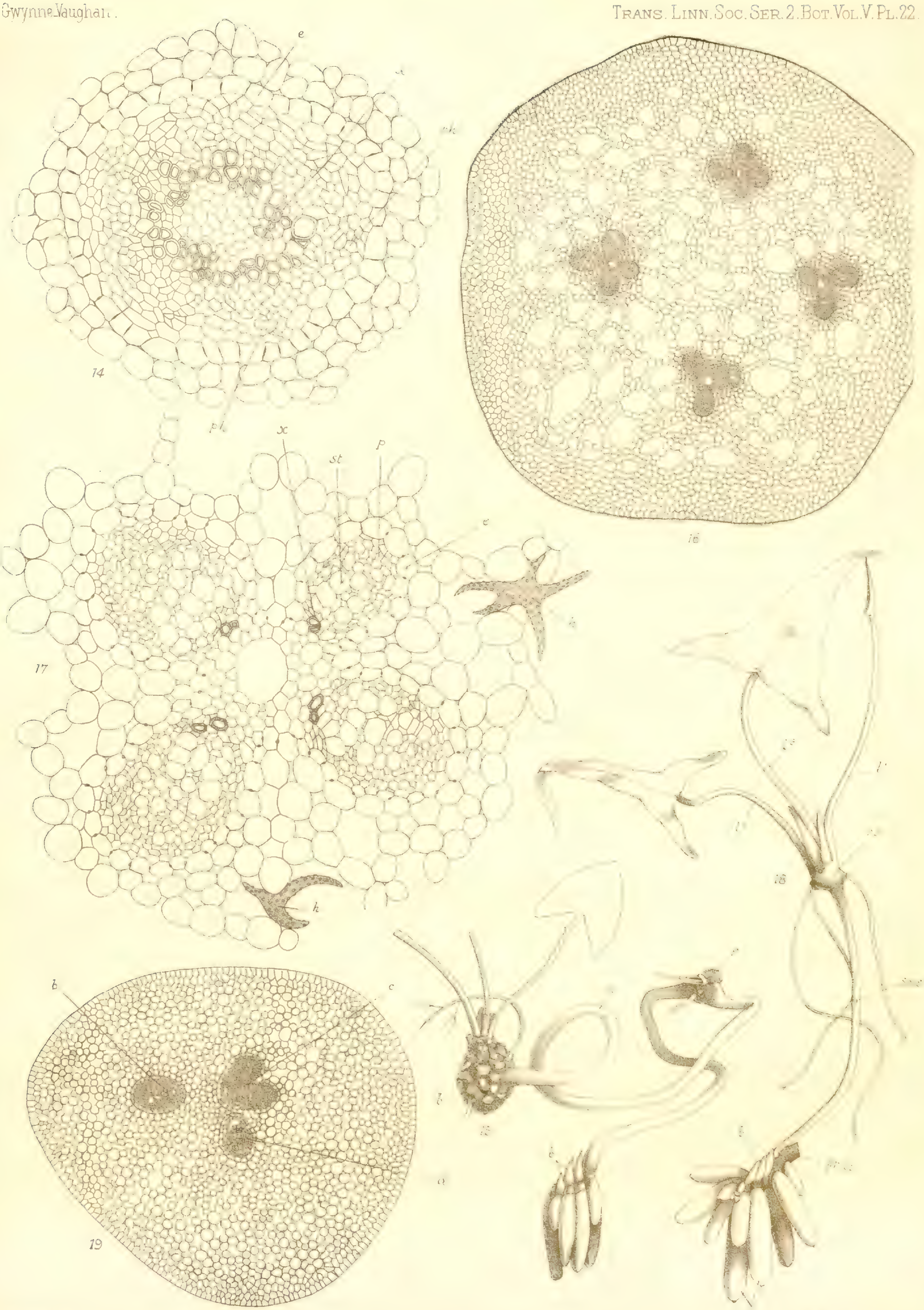

MORPHOLOGY & ANATOMY OF THE NYMPHÆACEÆ

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ON "TRANSFUSION-TISSUE": ITS ORIGIN AND FUNCTION IN THE LEAVES OF GYMNOSPERMOUS PLANTS.

BY

W. C. WORSDELL.

(*Communicated by* D. H. Scott, Ph.D., F.R.S., F.L.S., &c.)

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VIII. *On "Transfusion-tissue": its Origin and Function in the Leaves of Gymnospermous Plants.* By W. C. WORSDELL. (*Communicated by* D. H. SCOTT, *Ph.D., F.R.S., F.L.S., Hon. Keeper of the Jodrell Laboratory, Royal Gardens, Kew.*)

(Plates XXIII.-XXVI.)

Read 4th November, 1897.

THIS paper, which has been preceded by a short preliminary thesis, presenting only the chief facts (Journ. Linn. Soc., Bot. vol. xxxiii. pp. 118-123), furnishes a more detailed and elaborate account of the subject therein dealt with. It treats at some length of the origin and distribution of transfusion-tissue in the foliar organs of Gymnospermous plants.

This tissue is well known to be universally present in the leaves of Conifers; it occurs generally in the leaves of Cycads, and in those of *Ephedra* and *Welwitschia* among the Gnetaceæ. Among Angiospermous plants it is known to occur here and there in leaves and stems, but in these cases in a more or less modified form.

No one, however, as yet, has been able to give a satisfactory account of the origin and homology of this important and striking tissue. This I hope to be able to do in the following pages.

Historical Survey.

The first discoverer of "transfusion-tissue" was the German botanist Frank, who, in an important paper*, describes it in connection with the vascular bundle of the leaf of *Taxus baccata*, Linn. As regards its origin, he considers it to arise from the bundle, having noticed transitions in the shape and size of the tracheides from the ordinary xylem of the bundle outward to the transfusion-tissue at its side.

Thomas † mentions transfusion-tissue in the leaves of three genera of Conifers. He believes it to be parenchymatous in origin.

A paper by Kraus ‡, "Ueber den Bau der Cycadeenfiedern," dealing with the minute structure of the leaves of various Cycadean genera, does not mention the transfusion-tissue proper, but describes, in the genus *Cycas* (probably for the first time), the tracheides of the "accessory transfusion-tissue" running at right angles to the midrib towards the margin of the leaf, and which are characteristic of, and peculiar to, this genus.

In 1871 Mohl published an interesting paper § on the structure and morphology

* "Ein Beitrag zur Kenntniss der Gefässbündel," Bot. Zeit. 1864.

† "Zur vergl. Anat. d. Coniferen Laubblätter," Pringsh. Jahrb. Band iv. 1865.

‡ Pringsh. Jahrb. 1865.

§ "Morph. Betrachtung der Blätter von *Sciadopitys*," Bot. Zeit. 1871.

of the leaf of *Sciadopitys*. He is the first author to use the word "transfusion-tissue," applying it to the tracheides found in the tissue around the xylem of the bundle in this plant. He agrees with Thomas that it belongs to the parenchymatous tissue of the leaf, and not to the bundle.

Bertrand *, in a general sketch of the anatomy of the stems and leaves in the Gnetaceæ and Coniferæ, describes and figures transfusion-tissue in several genera, but does not enter into much detail concerning it.

De Bary † affords us the completest and clearest account given by any author of the transfusion-tissue as it occurs in the leaves of Gymnosperms, and illustrates his description by two very good figures of leaf-bundles of *Cunninghamia* and *Juniperus communis*, Linn. He does not attempt, however, to explain its origin.

Zimmermann's description ‡ of transfusion-tissue is one of the best and fullest. He rightly argues that a sharp distinction must be made between the large elongated tracheides running out to the margin of the leaf in *Cycas* and *Podocarpus* (which are specially modified from the parenchyma) and the real transfusion-tissue at the side of the bundle.

There is an excellent paper by Scheit §, entitled "Die Tracheidensäume der Blattbündel der Coniferen," which is worthy of special notice. He made a minute investigation into the character of the bordered pits and thickenings of the tracheides of the transfusion-tissue in many genera of Coniferæ. Of the transfusion-tissue of the Cycadeæ he does not say much, but finds it to agree entirely in most points with that of the Coniferæ. He makes an interesting study, with regard to this tissue, of the Gnetaceæ. He regards the reticulate venation of the foliage-leaf of *Gnetum* as a transition between the rudimentary venation of *Ephedra* and Conifers and the complex venation of Dicotyledons. But it is very questionable whether he is right in regarding the short tracheides which occur at the point of branching of the bundles and at their final endings as equivalent to the transfusion-tissue of Coniferæ. It is, however, of the greatest interest to find that the *bracts* of *Gnetum Gnemon*, Linn., which externally resemble the foliage-leaves of *Ephedra*, have the same rudimentary venation (though here consisting of five to six bundles), and also well-developed transfusion-tissue accompanying the bundles. He appears to be the first author to thoroughly investigate transfusion-tissue from the physiological point of view. At the opening of the paper the tracheidal nature of its elements, ascertained by reference to their mode of thickening, watery contents, and the closed character of the bordered pits, is fully discussed; at the close he considers the factors which determine the mode of thickening of the transfusion-tracheides and the development of the tissue as a whole. The chief factor determining the character of the wall appears to be the greater or less exposure to the turgescence of the surrounding parenchyma-cells; in the former case reticulate and other thickenings are present on the wall, in

* 'Bibliothèque de l'École des Hautes Études,' tome xii., art. no. 1, 1875.

† 'Comp. Anat. of Phanerog. and Ferns,' p. 380, 1877 (Engl. ed. 1884).

‡ "Ueber das Transfusionsgewebe," Flora, 1880.

§ Jenaische Zeitschr. f. Naturwiss., Band xvi. 1883.

the latter these tend to disappear and bordered pits to be alone present. The development of the tissue as a whole he considers to depend on the amount of transpiration to which the leaf is subjected—this, again, depending on the habitat.

As regards the origin of the transfusion-tissue, he approaches nearer to the truth than any other author. These are his words:—"Wherever, in the mature condition, the transfusion-tissue is found surrounding the phloem or the xylem, or both, *its origin lies in the xylem, as it completely passes over into the latter.*" This is, nevertheless, a vague statement, and not very much value can be attached to it.

The paper, as a whole, is extremely suggestive, and, I think, has been rather overlooked by subsequent writers.

A dissertation by Vetters *, entitled 'Die Blattstiele der Cycadeen,' gives a most minute and thorough description of the structure of the petioles, and the course of the bundles in the pinnæ, of all Cycadean genera. There is a careful and accurate account of the "accessory transfusion-tissue" in *Cycas*; and he also notifies the occurrence, though under varying forms, of the normal transfusion-tissue on the side of the bundles of the pinna.

The most accurate and thorough investigation of transfusion-tissue, as it occurs in the group Abietineæ, which has hitherto been made is that by Daguillon †. He is the first to define the exact tissue of the leaf in which, in this group, the tracheides occur, viz. the pericycle. He is careful to notice the various positions with regard to the bundle which the tracheides of the transfusion-tissue occupy respectively in the cotyledon and foliage-leaf. He finds that in the cotyledon of *Pinus sylvestris*, Linn., they occur opposite the protoxylem; in the foliage-leaf, on the contrary, chiefly round the phloem; an intermediate stage is presented in the "primordial" ‡ leaf, where the pericyclic sclerenchyma, which he holds to be homologous with the transfusion-tissue, extends round both xylem and phloem, being most abundant round the latter. His figures illustrating these points are the clearest and finest ever published.

A great authority on the subject, Van Tieghem §, describes the occurrence and the varying positions of transfusion-tissue in the leaves of Conifers. He recapitulates the statements of Frank, Mohl, and De Bary as to its origin, concluding that the views of these authors are inadmissible, and that the transfusion-tissue, from his own observation, belongs morphologically to the *peridesm* (pericycle) of the bundle.

Lignier ‖, the latest author dealing with the subject, discusses the homology of the transfusion-tissue in the pinna of *Cycas*, and finds that the tracheides of the "accessory transfusion-tissue" which traverse the mesophyll to the margin of the leaf merge

* Inaugural Dissert., Leipzig, 1884.

† "Recherches sur les Feuilles des Conifères," Revue générale de Bot. tome ii. 1890.

‡ The "primordial" leaves are the first-formed leaves of the seedling, which succeed the cotyledons, and occur singly and scattered around the stem; they possess a flattened lamina with a single bundle, thus differing considerably from the later-formed "needles."

§ "Sur les Tubes criblés extralibériens et les Vaisseaux extraligneux ('needles')," Journ. de Bot., 1891.

‖ "La Nervation téniopteridée des Folioles de *Cycas* et le Tissu de transfusion," Bulletin de la Soc. Linn. de Normandie, sér. IV. tome vi. fasc. 1.

insensibly into the tracheides of the normal transfusion-tissue immediately adjoining the bundle, and that there is thus no real distinction to be made between the two. He considers the transfusion-tissue in the leaf of *Cycas* and of all Gymnosperms, not as a later structure than the bundle, but as the remnant of a dichotomously-branched venation which was a common feature in their ancestors, and is still found in the allied genus *Stangeria* and in some Ferns.

In another important and interesting paper * he establishes the fact that the vascular bundle-system in the pinnæ *of all Cycads* is really dichotomous, though, owing to the fact that the branching of the bundles sometimes takes place in the very base of the pinna or on the outermost edge of the rachis, this feature, though often obvious even to superficial observation, has not been recognized as generally characteristic of the order.

Strasburger † describes fully the position and structure of the transfusion-tissue in the leaves of Gymnosperms, especially those of Coniferæ and Cycadeæ; his book is certainly the best compendium for a general and accurate account of the anatomy of Gymnospermous leaves.

General Considerations.

Transfusion-tissue consists of short tracheides, parenchymatous in shape, and with reticulate or other thickenings or bordered pits, on all the walls (Pl. XXIII. fig. 1). Its usual position is at the sides of the bundle in the pericyclic region; but it may frequently extend, as in *Araucaria* and *Libocedrus*, in an arc round the protoxylem, or it may, as in *Picea* and *Pinus*, completely encircle the bundle. Its evident function, as has been rightly inferred by various authors, is to supplement, in the leaves of these plants, what must be considered a rudimentary conducting-system. In a number of Conifers the leaf is traversed by but a single bundle (in some Abietineæ by two closely-contiguous bundles); in others, and in most Cycads, by a number of widely-separated, parallel bundles. In all these plants there is an entire absence of the complex, reticulate system of conducting-tissue, such as is met with in Dicotyledonous plants, and which must be considered the highest type of venation in the vegetable kingdom. In order to compensate, therefore, for the lack of an efficient conducting-system in the leaf, recourse has been had to the development of these peculiar tracheides (often accompanied by bast-cells of similar shape), now known as "transfusion-tissue." In *Cycas* and many species of *Podocarpus*, in which the broad pinnæ or leaves are traversed by a single bundle, in addition to the normal transfusion-tissue, a new and accessory system has been developed, running from the bundle to the margin of the leaf. This, however, as will be shown later on, is a purely secondary modification of the mesophyll-cells, and bears only a functional relation to the normal transfusion-tissue, having therewith no homology whatever. In the pinna of *Stangeria* a dichotomizing system of *closely-placed* veins springs from the large central midrib. In the pinnæ of all other Cycads, and in

* "La Nervation des Cycadées est dichotomique," Assoc. Française pour l'Avancement des Sciences. Congrès de Caen, 1894.

† 'Ueber den Bau und die Verrichtungen der Leitungsbahnen,' Jena, 1891.

Podocarpus Nageia, R. Br., *Dammara*, and *Araucaria*, among Conifers, a system of parallel venation prevails, and here transfusion-tissue is markedly developed.

The leaves of most Conifers are very narrow, and are traversed by a single bundle, which, in all cases, is provided with well-developed transfusion-tissue.

Ginkgo differs widely from all other Conifers in having a dichotomizing system of bundles traversing its large, fan-shaped leaf, and has transfusion-tissue present in connection with its rather widely-separated bundles, though more feebly developed than in most Conifers.

In order to prepare the way for my subsequent remarks, I will first of all describe the structure of the vascular bundle in the lamina of an ordinary foliage-leaf of a Cycad. It is well known that the bundles of the leaf of Cycads have a structure peculiar to this order and not found in any other living group of plants. Towards the dorsal (lower) surface of the lamina is placed the phloem; next comes the ordinary xylem, which is formed by the cambium in a centrifugal * manner; on the inner side of the secondary wood there may or may not be a few elements of primary centrifugal wood, and then follows the protoxylem, consisting of narrow, elongated, spirally- or reticulately-thickened elements. Farther, beyond the protoxylem, *i.e.* between this tissue and the ventral (upper) surface of the leaf, occurs another strand of xylem, primary in origin, and of much greater development than that of the centrifugal wood; it is *centripetal* in development, *i.e.* its elements are formed successively from the protoxylem towards the ventral (upper) surface of the leaf; it is characteristic of the Cycadeæ. Typical transfusion-tissue occurs at the side of the bundle, and this is seen to be in intimate connection with the centripetal xylem (Pl. XXIII. fig. 2). In the petiole the structure of the bundles is the same, though their orientation is different. In other Gymnosperms and all Angiosperms this tissue is, so far as hitherto observed, absent from the vascular bundle. No trace of any such tissue has previously been observed either in the leaves of the Coniferæ or of the Gnetaceæ. According to existing observations, the structure of the bundle in these two latter groups of plants, as in all Angiosperms, is *endarch*, in contradistinction to that of the leaf of Cycadean plants, which is *mesarch* †.

Original Observations.

An investigation into the structure of the *cotyledons* of some seedlings of *Ginkgo biloba*, Linn., grown in the Royal Gardens, Kew, revealed a most interesting and novel structure. The cotyledons, as in the Cycadeæ, are rudimentary, hypogeal structures.

* The terms "centripetal" and "centrifugal," applied to the development of the parts of the bundle, are used with reference to the centre of the stem, in such a way that, in the case of the xylem starting from the first-formed tracheæ (protoxylem), elements formed successively near the phloem, *i.e.* towards the outside of the stem, are called "centrifugal," and those formed successively in the direction away from the phloem, *i.e.* towards the centre of the stem, are said to be developed "centripetally." The same terms ("centripetal" and "centrifugal") are applied to the development of the bundles in the leaf, whatever may be their orientation.

† The term "mesarch" was first suggested by Solms-Laubach (Introd. to Fossil Bot., Engl. ed. p. 257) to define the mode of development of the xylem of the bundle in Cycadean plants. In such plants the protoxylem occupies a central position in the xylem of the mature bundle. This term was first definitely adopted by Williamson and Scott in describing the structure of the stem-bundles in the fossil plants *Lyginodendron* and *Heterangium* (Phil. Trans.

They are thick and fleshy in consistence, bearing little, if any, resemblance to leaves, and are closely adpressed by their ventral faces, though not completely connate, as in the Cycadeæ. The tip of each is slightly notched. The cotyledons are traversed each by two bundles which in shape, as seen in transverse section, are curved in the form of an arc of a circle. There is a great development of the phloem of the bundle. The centrifugal part of the xylem is but very feebly developed; some of its elements can be seen to be secondary and cut off by the cambium, some of the smaller and innermost are probably primary. To the inside of the latter lies the small group of protoxylem. On the ventral side of the protoxylem, however, and directly opposite the latter, there are yet other tracheides present with densely spiral thickenings, which, by their position and relative development, I determined to be none other than the equivalent of the centripetal xylem as it occurs in the bundles of Cycadean leaves. These tracheides are very much scattered (Pl. XXIII. fig. 3). A row of three, however, more compactly grouped, show clearly the nature of the bundle, to which the term "mesarch," as descriptive of the bundle of Cycadean leaves, may fitly be applied. The remaining tracheides occupy various positions. In proportion as they recede farther from the protoxylem towards either side of the bundle, they attain a greater diameter and are provided with reticulate bars of thickening on their transverse walls; they moreover assume a perfectly angular outline as seen in transverse section. In fact, they present very much the appearance of the tracheides composing the transfusion-tissue in the leaves of Coniferæ. One or two of these tracheides which most completely resemble transfusion-tissue are situated quite on the side of the bundle and bordering on the phloem (fig. 3). In longitudinal section of the bundle, a most evident and interesting transition is seen between the tracheides nearest the protoxylem, which are elongated and narrow in shape, much resembling the elements of the latter, and those which are farthest removed from the protoxylem, which are short and stout, thus entirely different from the former tracheides, and in every way similar to the elements of the transfusion-tissue of Coniferous leaves (fig. 4). In the bundles of the lamina of the *foliage-leaf* of *Ginkgo*, tracheides, to the number of one or two, are usually present on the ventral side of the protoxylem, but, compared with the cotyledon, the centripetally-formed xylem is here very much reduced. There is typical transfusion-tissue at the sides of the bundle, consisting of wide tracheides with conspicuous reticulate thickenings and bordered pits (Pl. XXIII. fig. 5). In the bundles of the petiole there is a great development of the secondary centrifugal xylem; consequently, the number of elements of the centripetal xylem is exceedingly reduced, the tracheides being very inconspicuous and scattered (Pl. XXIV. fig. 6). Fig. 7 shows a good

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Roy. Soc. vol. 186 (1895) B, pp. 703–779). The term "endarch," kindly suggested to me by Dr. D. H. Scott, is employed here for the first time to define the structure of a bundle in which, as in the stems of the great majority of Phanerogams, the whole of the later-formed xylem is centrifugal, *i. e.* is developed towards the phloem, the protoxylem always occupying the innermost portion of the bundle. Van Tieghem (Traité de Bot. pp. 763 & 764) uses the two terms *perixylic* and *centroxylic*; the former would include the terms "mesarch" and "exarch," the latter would be the equivalent of "endarch."

example of such a tracheide in longitudinal section. In this part of the leaf the transfusion-tissue is also but little developed.

A study of the structure of the bundles in the cotyledons of *Cycas revoluta*, Thunb., revealed something very similar to what was found in those of *Ginkgo biloba*, Linn. There are a number of bundles in each cotyledon, arranged somewhat in the form of a triangle. Here, as in *Ginkgo*, there was a relatively small development of the centrifugal, but a great development, on the contrary, of the centripetal xylem. Here also, in the latter tissue, could be distinctly seen a transition between the elements nearest the protoxylem, which were elongated and of small diameter, and other elements which were short, of great diameter, and possessing conspicuous bordered pits on their transverse walls, which occurred scattered in the ground-tissue, often at a considerable distance from the bundle and chiefly in a lateral direction. It was interesting to see how some of these tracheides extended round towards the phloem, exactly as occurs in the bundles of the mature foliage-leaf (figs. 8 & 9). In fig. 10 is represented a longitudinal section of a similar bundle.

I will now proceed to consider the structure of the vascular bundles of the foliar organs of Gymnosperms generally. This may be deemed, perhaps, a rather useless task, as botanists may assert that the structure of the leaves of these plants is already well known. Nevertheless, I hope, before the close of this paper, to exhibit a feature of considerable importance which has hitherto apparently been unsuspected by all investigators.

I will begin with the order Cycadeæ. These plants are known to be intermediate in their general structure between Conifers on the one hand and the great Fern-group on the other. In the structure and general appearance of the leaf *Stangeria* certainly approaches nearest to the Ferns. The broad, elongated pinnæ of the leaf are traversed by a single thick midrib; from this a dense venation of dichotomizing bundles radiates out on either side to the margin of the leaf. The vascular bundle, as in all Cycads, possesses centripetal, as well as centrifugal, xylem. Transfusion-tissue, though inconspicuous and of small development, is present at the sides of the bundles. It is conceivable that *Cycas*, in the structure of its leaf, may be a nearer relative than any other Cycad to *Stangeria*. The pinnæ, while retaining the single midrib in much reduced form, have become, relatively to their length, very much narrower, as a consequence of which the lateral veins, typical of *Stangeria*, have completely disappeared, leaving the pinnæ provided with but a single vascular strand, the remnant of the bundles traversing the much thicker midrib of the pinna of *Stangeria*. Of the tissues composing the bundle in the midrib of *Cycas*, the centrifugal xylem is, as in all Cycads, but feebly developed, and is secondarily formed by the cambium. The centripetal xylem, on the contrary, is extremely well developed, and consists of tracheides increasing in diameter as they extend towards the ventral side. The transfusion-tissue, forming a dense group of tracheides at the sides of the bundle, is that typical of all Cycads. In the intermediate pericyclic region there extends in an oblique direction a group of tracheides connecting the main part of the centripetal xylem with the

transfusion-tissue at the end of the phloem. In this group of tracheides could be observed, both in transverse and longitudinal sections, a most interesting transition in the character of the elements. Starting from the large tracheides of the main part of the centripetal xylem, we first come to the small tracheides of the connecting group, which approximate in size to the tracheides of the centrifugal wood, and pass from these to the elements of the transfusion-tissue, in which, at first, a gradual thickening of the walls can be noticed, then a shortening in length and an increase in diameter of the elements, until they merge into the ordinary parenchyma-shaped tracheides which form the bulk of the transfusion-tissue (Pl. XXIII. fig. 2). These tracheides sometimes occur among the stone-cells of the endodermal ring; in other cases it appears that communication takes place between the tracheides in the pericycle and those in the mesophyll through a stone-cell of the endodermis, which (and this is invariably the case) at this point *has no contents*, while the stone-cells on either side contain numerous crystals.

But I now have to deal with a tissue in the leaf of this plant which is unique among Cycads. Stretching amidst similarly elongated cells in the central region of the mesophyll of the leaf, from the midrib to the margin, is a band of conspicuous tracheides, narrow and elongated in shape and with bordered pits on their walls. These bordered pits are mostly of a rather rudimentary type, with wide slit-like pores, but in many of the tracheides nearest the vascular bundle they are more typical in appearance. These tracheides are in intimate connection, by means of their wide, expanded ends, with the small tracheides of the transfusion-tissue. They form a loose complex of tissue extending along the whole length of the leaf in a plane parallel to its two surfaces (Pl. XXIV. fig. 11). Lignier * has attempted to account for this tissue by regarding it as the remnant of a lateral system of dichotomizing bundles such as that found in the leaf of *Stangeria*. He appears to offer no special reason for this assumption, but founds it merely on the general structure and appearance of these strands of tracheides. Now, to my mind, the general arrangement and structure of this tissue are precisely the characters which prevent any such origin as that proposed by Lignier being attributed to it. It is almost impossible to suppose that the regular venation of a leaf like that of *Stangeria*, with distinct and conspicuous intervals between the veins, could have been transformed into the irregular strands of anomalous tracheides which occupy the entire middle portion of the leaf, with the exception of the mesophyll-cells, narrow and elongated like themselves, which lie scattered among them. Far more probable does the explanation seem that these tracheides are a later modification of the mesophyll-cells of the leaf, which has been adopted *since* the narrowing of the leaf and the loss of the lateral veins. Lignier also considers the normal transfusion-tissue, as found in Gymnosperms generally, to be a remnant of such a lateral system of venation. That this idea is equally false I hope to show clearly before the close of this paper. If it can be proved that the normal transfusion-tissue is in no wise such a remnant as he supposes, but is an independent formation, then this would be an additional proof that the anomalous transfusion-tissue

* Bulletin de la Soc. Linn. de Normandie, sér. IV. tome vi. fasc. 1.

of *Cycas* is also an independent formation, as how otherwise can one account for the intercalation of the normal transfusion-tissue between the midrib and this "bundle-remnant"? This "accessory transfusion-tissue," as I propose calling it, is, as Lignier rightly says, an extension of the transfusion-tissue proper, the latter being, as it seems to me, an older formation, acquired by the ancestors of the plant soon after the lateral veins were dropped, and the former, as it were, an afterthought to ensure a more perfect supply of water to the distant cells of the broad lamina of the leaf; there may also be much truth in Zimmermann's view, that this tissue serves the mechanical purpose of strengthening the leaf, in the same way as would a system of lateral veins.

In all other Cycads a *dichotomous* system of venation prevails without any midrib whatever. This dichotomy is sufficiently evident and conspicuous in the broad pinnæ of *Bowenia* and *Zamia*, and may also be seen pretty clearly at places in the lamina of *Ceratozamia*. In those genera with narrower pinnæ, such as *Dioon* and *Macrozamia*, the dichotomy is quite obscured and hidden from superficial observation owing to the fact that, as Vetters and Lignier showed, and as I have myself since verified, the branching of the bundles takes place low down in the very base of the pinna, or in the extreme edge of the rachis; as, subsequently, no further branching occurs higher up in the pinna, the result is a series of parallel veins of equal strength traversing the mesophyll. In all these other genera normal transfusion-tissue is present at the sides of the bundle, as in *Cycas*. But the elements composing it are always inconspicuous and scarcely recognizable as transfusion-tissue such as it is seen in *Cycas*. They are often clearly seen in connection with the centripetal xylem extending along the sides of the bundle. It is only occasionally that these elements exhibit bordered pits or reticulations on their transverse walls (Pl. XXV. fig. 12). Vetters, while recognizing the presence of these tracheides, refused to regard them as equivalent to the transfusion-tracheides of *Cycas*; but I have no doubt that he was wrong in this respect.

In the order Coniferæ there obtains a far greater diversity in the conformation of the foliage-leaf than in the order we have just been considering. *Ginkgo* stands entirely alone both as regards the shape and the venation of its leaf, and clearly indicates a much less modified and more primitive type of structure than is found in any other genus of the order. The broad fan-shaped lamina and dichotomous venation sufficiently prove this to be the case.

As I have already dwelt upon the structure of the vascular bundle in the foliar organs of *Ginkgo*, I will now pass on to its nearest allies among the Coniferæ, viz. the Taxineæ. In these the leaves are much reduced and in no wise resemble those of *Ginkgo*.

Cephalotaxus drupacea, Sieb. & Zucc.—In the *cotyledon* of this plant the bundles, which are the least varying parts of the leaf, present a structure strikingly similar to what obtains in *Ginkgo*. Transfusion-tissue is scarcely to be distinguished, and is only represented by some tracheides at the corner of the centrifugal xylem. The *centripetal xylem*, on the other hand, as seen in transverse section, is very well developed, forming a nearly continuous band along the ventral side of the bundle, and consisting of

large round tracheides, the smaller of which lie towards the protoxylem of the bundle. This protoxylem stretches right across the intervening space between the centrifugal and centripetal parts of the xylem, the latter tissue having even some protoxylem elements attached to it (Pl. XXV. fig. 13). The centrifugal xylem has a fair development, an active cambium being present. This bundle is therefore extremely interesting as forming in its structure a connecting-link between that of the cotyledonary bundles of *Ginkgo* and of other Coniferæ.

Cephalotaxus Fortuni, Hook.—In the *cotyledon* and *leaf*, as seen in transverse section, the transfusion-tissue, as in all Coniferæ, is very well developed at the sides of the bundle; but in addition to this, there are nearly always a variable number of tracheides of much smaller diameter on the *ventral* side of the xylem. They lie scattered, in various positions, among the parenchyma-cells of this region, and are quite distinct and separate from either the protoxylem or the transfusion-tissue. In longitudinal section of the bundle these tracheides are very clearly shown on its ventral side, directly opposite the oldest, spiral elements of the protoxylem, and separated from these by one, two, or three layers of cells. In shape they are somewhat elongated, with square or tapering ends, and reticulate thickenings, with or without bordered pits, on their walls (fig. 14); those nearest the protoxylem have reticulations alone, those farthest away in the ventral direction have bordered pits intercalated between the thickenings. These tracheides, seen thus in both sections, as in the above species, are constituents of the *centripetal* xylem and equivalent to the tracheides observed on the ventral side of the bundle in both the cotyledon and leaf of *Ginkgo*.

Taxus (2 species).—In the cotyledon and leaf I was able to discover similar tracheides, though they appeared in this genus scarcely so conspicuous as in *Cephalotaxus*. These elements, of which, in one transverse section, I observed three, were separated from the protoxylem (whose limit on the ventral side was well defined) by a single layer of cells. From their superiority in size to the elements of the protoxylem they could not possibly be outlying members of that tissue. The finely-developed transfusion-tissue at the side of the bundle showed in places an interesting transition in the size of its elements from its extreme outer side, where the tracheides were large in diameter and conspicuously pitted, to its innermost part, nearest the protoxylem, where the final tracheide, in one instance observed, much resembled, in size and in the character of the wall, the elements of the centripetal xylem above-mentioned (fig. 15). In longitudinal section of a leaf-bundle short, reticulate tracheides were observed here and there on the ventral side of the protoxylem, which appeared to occupy the same position with regard to the latter tissue as did those seen in transverse section; they were also of about the same diameter. Thus in the leaf of this plant also we find a conspicuous instance of centripetal xylem.

Podocarpus chilina, Rich.—This plant has long, pointed, and rather broad leaves, provided with a single median vein or midrib. At the side of this bundle the normal transfusion-tissue is remarkably conspicuous, constituting a group of large, pitted tracheides (fig. 16). In a horizontal section of the leaf, *i. e.* one made parallel to its

surfaces, it can be seen that the transfusion-tissue is bordered, on the side away from the bundle, by a single layer of parenchyma-cells similar in shape to its own tracheides. Immediately abutting on these, however, by their expanded ends are to be seen strands of lignified elements which, starting from this region, run out through the mesophyll to the margin of the leaf (fig. 16). In arrangement, shape, and general appearance they resemble extremely the strands of "accessory transfusion-tissue" in *Cycas*. But the individual elements present a remarkable difference from those of the "accessory transfusion-tissue" in *Cycas*, from the fact that they possess narrow, slit-like *simple* pits in their walls without the remotest trace of any border. From the thickness and consistence of their walls, the simple pits, and the scattered arrangement of these latter, they have very much more the appearance of stone-cells than of tracheides, and it is possible that they are analogous to the tracheides occupying the same position in *Cycas* only in so far as the mechanical function of strengthening the broad lamina of the leaf is concerned, and that they therefore do not possess in any way a conducting function.

Podocarpus Totara, G. Benn.—In the much shorter and narrower leaf of this species it is interesting to note the complete absence of this tissue in the leaf. Here the central mesophyll-cells are elongated in the direction of the margin of the leaf, but are thin-walled and unpitted. I was able to determine, however, the presence of a very slight lignification of their walls.

P. alpina, R. Br.—In the still smaller and evidently much reduced leaf of this species the same entire absence of this tissue was to be seen. Here and there, however, in the central region of the leaf, and occupying the same position as the thick-walled, pitted elements of *P. chilina*, Rich., occurred one or two large stone-cells. One of these abutted directly, by its narrower end, on the cells immediately adjoining the normal transfusion-tissue. Another was seen to be in intimate connection with an assimilating cell of the parenchyma. Except for their greater diameter, these cells looked exactly like the elements above described in *P. chilina*, Rich. I am tempted to regard them as a relic and last vestige of the well-developed tissue as seen in *P. chilina*, Rich., the latter, owing to the great reduction of the leaf in breadth, as well as in length (probably from its exposed habitat on the mountains), having become no longer necessary. As regards the structure of the leaf of *P. Totara*, G. Benn., it may possibly also be a reduction from the type of *P. chilina*, Rich., but it is impossible to be certain of this. The stone-cells, in the two species examined, are devoid of contents.

In this genus there appeared no sign of centripetal xylem attached to the bundle, as in other Taxineæ.

Araucaria excelsa, R. Br.—Having at my disposal a seedling with four cotyledons, I was able to thoroughly investigate the structure of the latter. Each cotyledon is oblong in shape, with a broad lamina traversed by about six vascular bundles and a number of hypodermal resin-canals. It is denticulate at the apex. A transverse section showed

large-celled transfusion-tissue occurring chiefly at the sides of the bundle, but also very frequently indeed on the ventral side of the xylem. A longitudinal section showed that the tracheides of the transfusion-tissue, both at the sides of the bundle and on its ventral side, were of various lengths, some being very long, others shorter; there is also considerable variation in their breadth, which is usually rather great. Here and there very long and comparatively narrow ones occur opposite the protoxylem, though not directly opposite its main part where the annular vessels occur. In one place, however, opposite such an annular vessel, a short, broad tracheide was observed. The parenchymatous elements immediately abutting on the protoxylem are, many of them, extremely narrow and of great length, tapering very much at the ends, owing to their having undergone a great amount of sliding-growth. The pitting of the tracheides of the transfusion-tissue and centripetal xylem is very interesting. These elements, at least those on the ventral side of the xylem, have very much the appearance of thin-walled sclerotic cells, and are in many cases almost, if not quite, indistinguishable therefrom, owing to the fact that the pits of many appear to be quite simple. It appears that a degeneration of the bordered pits has taken place such that the borders have become gradually obliterated, so that in most cases only a slight swelling of the wall around the pit has remained (Pl. XXVI. fig. 17). This slight thickening can be readily seen both in a sectional and a surface view of the wall. It is in some cases much more distinct than in others, and in such a definite border is seen. It is by means of these latter transitional cases that the real tracheidal nature of all these elements can be determined, and also that none of them are sclerotic cells. The cross-walls are often horizontal, but also very frequently rather oblique. I think there is but little doubt that these tracheides have all been derived from the centripetal xylem which once existed in normal form in the position in which these tracheides now occur, and that the latter have been since extremely modified.

Araucaria Bidwillii, Hook.—In a transverse section of the *cotyledon* the bundles are seen to be united into long bands. There is a great development of transfusion-tissue consisting of elements of various shapes, rounded or angular, reticulated or pitted, often of considerable size, on the ventral side of the protoxylem and immediately abutting on it; they may also be seen running out into the parenchyma. There are sometimes smaller tracheides next the protoxylem, which are rounded and appear like normal tracheides of the bundle, though larger. These constitute the *centripetal xylem.*

In a transverse section of the *leaf* a number of parallel bundles are observed traversing the broad lamina. Each of these has transfusion-tissue largely developed on all sides of the xylem, consisting of wide, angular tracheides with small bordered pits. But, abutting on the protoxylem, and connecting the latter with these large tracheides, are smaller ones with rounder, smoother walls, forming a transition between the protoxylem and the transfusion-tissue, and evidently representing *centripetal xylem.* In longitudinal section of the leaf there are no transitional elements between protoxylem and transfusion-tissue in direct connection with the main part of the former, *i. e.* where the elements with annuli and long-drawn-out spirals are situated. But a little to the

side of this, and still directly opposite spiral elements of the protoxylem, evident transitional elements are seen which represent centripetal xylem; these sometimes abut directly on the protoxylem, in other cases lie a short distance away from the latter. These tracheides are sometimes *of great length* and quite narrow, having the same shape as a tracheide of the protoxylem. They possess transitional characters in their walls, where rudimentary bordered pits with wide openings and large borders occurred in the midst of very fine and delicate, but regular and close, spiral or reticulate markings. Farther away from the protoxylem, in a radial direction, the tracheides gradually become shorter and stouter, this also happening in a tangential direction towards the sides of the bundle.

Araucaria imbricata, Pav.—In a transverse section of the *leaf* a number of small, parallel bundles are seen. At the sides of each bundle well-developed transfusion-tissue occurs; in many cases it curves round so that a group of its tracheides frequently comes to lie, by itself, opposite some part of the protoxylem; in such a case the tracheides of the group nearest the protoxylem are smaller than the others. In some cases, directly opposite the main part of the protoxylem, are seen one or two *small, round* elements of *centripetal xylem*. They afford a very clear instance of a remnant of this latter tissue (fig. 18).

Dammara sp.—A number of parallel bundles traverse the broad lamina, as in *Araucaria*. In transverse section the transfusion-tissue is seen to extend on all sides of the xylem, and there are also other smaller tracheides abutting directly on the ventral side of the protoxylem (fig. 19). In longitudinal section one or two of these latter elements are seen to be elongated tracheides with pointed ends and spiral thickenings situated immediately on the ventral side of the elements of the protoxylem with loose spirals. They thus exhibit an undoubted case of *centripetal xylem*. The transfusion-tracheides are of quite a different appearance and quite typical in character (fig. 20).

Sequoia gigantea, Lindl. & Gord.—In a transverse section of the *cotyledon* the single bundle possesses a very conspicuous development of the secondary centrifugal xylem. Only one or two elements of transfusion-tissue are present at the sides of the bundle. There are no tracheides on the ventral side of the xylem. In a similar section of the *foliage-leaf* there is seen to be a very much smaller amount of secondary centrifugal wood. The transfusion-tissue, on the other hand, has reached a greater development than I have seen in any other Conifer; its outermost tracheides being of very great diameter, nearly equalling that of the entire xylem of the bundle. The innermost are very much smaller. The nearest approach to centripetal xylem in this plant that I found was one of the innermost transfusion-tracheides, smaller than most of the others, which was situated in an intermediate position between these and the protoxylem.

Widdringtonia Whytei, Rendle.—In a transverse section of the *cotyledon* the trans-fusion-tracheides, which are of various shapes, both small and rounded and also very

large and angular, are scattered on all sides of the xylem, sometimes appearing in contact with the protoxylem. In longitudinal section they are seen to be short, broad elements with spiral thickenings and bordered pits. In a similar section of the *plumular leaf* it is interesting to note that the transfusion-tissue is confined to the sides of the bundle; there are no tracheides opposite the protoxylem, as in the cotyledon. This is what one would expect to find in passing from the more primitive to the more modified organ.

Libocedrus decurrens, Torr.—In a transverse section of the *cotyledon* the transfusion-tissue is seen to extend on all sides of the xylem of the single bundle, and there also appear to be transitional elements between the protoxylem and the transfusion-tissue. In a similar section of the *plumular leaf* the transfusion-tissue is seen to be present only at the sides of the bundle, and entirely absent from the region opposite the protoxylem. In a longitudinal section of the *cotyledon* it is seen that undoubted transitional stages between the protoxylem and the transfusion-tissue exist opposite the former, consisting of *elongated* tracheides with both spiral thickenings and bordered pits. To the outside of these the tracheides become shorter and have exclusively bordered pits. On the sides of the bundle the transfusion-tracheides are very much shorter and have either bordered pits or reticulate-spiral thickenings. They are usually greater in diameter than those opposite the protoxylem. In a longitudinal section of the *plumular leaf* the centripetal xylem, of *long* elements with reticulate-spiral thickenings, is seen to occur on the ventral side of the protoxylem, and there are transitions from these to the transfusion-tracheides, which are shorter and stouter.

Juniperus bermudiana, Linn.—In a transverse section of the *cotyledon* the transfusion-tissue of the small bundle is seen extending from the lateral position round to the ventral side of the protoxylem, where its tracheides are larger and also scarcely lignified; in some sections they are absent from this part. In a longitudinal section of the cotyledon a vertical row of rather short tracheides was observed opposite the protoxylem. In a transverse section of the *leaf* the transfusion-tissue occurs in a lateral position and is only somewhat inclined towards the ventral side of the xylem, not extending so far round in that direction as is the case in the cotyledon. This is interesting, as showing the gradual modification which has taken place in the more recent organ.

In the great group of the Abietineæ the transfusion-tissue is very characteristic and has been well figured and described by Daguillon *. It consists of tracheides of the usual shape, with very transparent walls and well-defined, circular, bordered pits. These occur in the pericyclic region, and usually extend completely round the bundle, forming a kind of cylinder of transfusion-tissue. In some it is chiefly found around the xylem, in others, again, chiefly around the phloem. Daguillon cites the case of *Pinus sylvestris*, L., where, in the bundles of the *cotyledon*, the transfusion-tissue occurs on the ventral side of the xylem, in the *foliage-leaf*, on the contrary, chiefly round the phloem. This, again, is a very suggestive and interesting case. In a transverse section of the *cotyledon* of *Pinus*

* Rev. gén. de Bot. ii. (1890).

Thunbergii, Parl., which I examined, I could, however, find no trace of transfusion-tissue anywhere.

Pinus Pinaster, Soland.—In a transverse section of the *foliage-leaf* the transfusion-tissue occurs all round the bundle. But besides these elements, there were observed, immediately on the ventral side of the protoxylem, a group of thin-walled, irregularly-shaped, rather small-celled elements with lignified walls. In a longitudinal section the parenchymatous elements abutting on the protoxylem appeared very much elongated, with either oblique or horizontal walls, and had undergone a great amount of sliding-growth. Among them were found tracheides with very small, but distinct, bordered pits; but in many of these thin-walled tracheides, which are of the same diameter and length as those of the protoxylem, the bordered pits are almost obliterated, and, in a great many, are entirely gone. It seems to me that these tracheides represent the last lingering remnant of the centripetal xylem, which is gradually becoming resolved into the parenchymatous elements above mentioned. Outside one of these tracheides just described were seen two tracheides of the transfusion-tissue, of which it is to be noted that the innermost is much more elongated and narrower than the other one, this latter representing the more normal form of these tracheides (Pl. XXVI. fig. 21).

The following plants afford additional instances in which I have observed centripetal xylem in the bundle of the leaf:—*Cupressus torulosa*, D. Don; *Cunninghamia sinensis*, R. Br.; *Saxegothea conspicua*, Lindl.; *Prumnopitys elegans*, Phil.; *Torreya californica*, Torr.; and *T. nucifera*, Sieb. & Zucc.

General Results.

Collating all these facts with the structure, as we have long known it, of the vascular bundle of the leaves of Conifers and Cycads generally, it appears to me that there is a clue to be found as to the origin of the transfusion-tissue in these plants. This tissue, as seen in the cotyledonary bundles of *Cycas* and *Ginkgo*, is clearly an extension towards the sides of the bundle of the *centripetal xylem* of the latter. As this tissue began to extend itself irregularly both in a ventral and in a lateral direction away from the protoxylem, the tracheides forming its lateral extension were finally fixed, and, occurring as they did at the sides of the bundle, bordering on the surrounding mesophyll of the leaf, were eventually made use of as a permanent and useful auxiliary conducting-system, this latter being found necessary on account of the inadequate distribution of the bundles in the mesophyll of the leaf. In the case of Conifers, where the centrifugal xylem has considerably increased in amount, the centripetal xylem, as such, tends to disappear, but persists in a modified form when of use as an auxiliary conducting-system. An objection to this view of the origin of the tissue in question has been raised on the ground that tracheides, such as those of the transfusion-tissue, may be formed anywhere, at any time, and from any tissue of the plant. The transfusion-tracheides, it is urged, may have been developed quite independently of the centripetal xylem, and have become directly continuous with its lateral region, from the fact that this part of the xylem is the most convenient for the attachment of the transfusion tissue. I quite admit the possibility

of such an origin for a transfusion-tissue, and a conspicuous instance thereof is found in the stem of *Casuarina* *, where transfusion-tissue, consisting of tracheides with simple pits and lignified walls, is formed directly from the parenchyma-cells immediately surrounding the cortical bundles, and, of course, here quite independently of any centripetal xylem, a tisssue which these bundles never possessed. But what I maintain is that in Gymnospermous plants the transfusion-tissue is nothing more or less than a direct extension of the centripetal xylem. This could scarcely be decided upon from an examination of the foliage-leaves of either Cycads or Conifers, but was conclusively revealed by an investigation of the cotyledons of these plants. The *transitions* in size and other characters which take place, both in a ventral and in a lateral direction, between the elements of the centripetal xylem directly opposite the protoxylem and those of the peripheral transfusion-tissue, left no doubt as to the truth of the above inference. Had the tracheides of the transfusion-tissue been formed independently from the pericyclic or mesophyll-cells around the bundle, I see no reason why there should have been found such easy and delicate transitions in size, &c., between these and the centripetal xylem. It is true that there is a difference in size, both of diameter and length, between the cells of the mesophyll and those of the pericycle; but this, though it might possibly account for the transitions in size and shape above mentioned, yet would not account for the transitions in the characters of the cell-wall which are frequently met with, nor, indeed, for the fact that in the cotyledonary bundles the transfusion-tissue is better developed on the *ventral* than on the lateral side of the bundle. In the cotyledonary bundle of *Ginkgo*, as indicating the place of its origin, the tracheides of the transfusion-tissue are frequently seen to be mingled with the ordinary tracheides of the centripetal xylem, and, in one case, an element of the former, with reticulations on its transverse wall, was seen jammed in between two elements of the latter tissue. Again, if the transfusion-tissue were a distinct and independent formation, it would, I imagine, not be so conspicuous in the cotyledons, *e. g.* of *Ginkgo*, as is in reality the case. In these organs it can have but little function to perform. In the foliage-leaf, on the contrary, of *Ginkgo*, where the importance of its function is obvious, it is but very sparingly present as compared with its occurrence in the cotyledon of this plant. The *raison d'étre*, then, of its having an origin independent of the centripetal xylem in this case falls to the ground, while my own view, that the transfusion-tissue is a modification of the centripetal xylem, is clearly supported by these facts.

That in those cases, of which there are several, where the transfusion-tissue is in direct connection with the *centrifugal* xylem, there are seen to be transitions in size between the elements of the two tissues, does not affect my position when it can be shown that this is a purely secondary result, for in the cotyledonary bundles of *Ginkgo* and *Cycas*, and in several other plants which I have examined, the transfusion-tissue is always to be seen extending out from the region on the ventral side of the protoxylem. The transition just mentioned is due, doubtless, to the difference in size between the parenchyma-cells immediately adjoining the bundle, viz. those of the pericycle, and those, belonging to the ground-tissue of the leaf, lying farther away.

On the whole, then, I think the facts justify my position, viz. that the normal

* "On the Comparative Anatomy of the Casuarinæ," etc., Ann. Bot. vol. viii. (1894).

transfusion-tissue (not the "accessory transfusion-tissue"), as at present known in the foliar organs of Gymnosperms, is not an outlying tissue of no morphological value with regard to the vascular bundle to which it is attached, but that it has a distinct and definite origin in this bundle, viz. from the centripetal xylem; that it was *the successive, unlimited, centripetal development* of the tracheides of this latter tissue which, generations back, afforded, as it were, *the first start*, which has eventually culminated, in more modern plants, in the characteristic transfusion-tissue at the side of, or in various positions around, the vascular bundle. The albuminous cells or "phloem transfusion-tissue," called by Strasburger "Uebergangszellen," appear to arise, on the contrary, quite independently, from the parenchyma-cells immediately flanking the phloem. Though evidently similar in their function of conducting substances between the cells of the surrounding mesophyll and the bundle, the two kinds of transfusion-tissue have, nevertheless, a very different origin, the one springing from the vascular tissues of the bundle itself, the other from the parenchyma lying outside these vascular tissues. The former, the xylem transfusion-tissue, is not, as some have supposed, a distinctly new tissue derived from the parenchyma of the ground-tissue of the leaf, or even of the pericyclic cells; nor is it again, as others have imagined, the equivalent of a lateral vein or branch of the bundle. The conclusion at which I have arrived is that this tissue is *a direct derivative of the centripetal xylem* which normally occurred as an important part of the vascular bundle in the ancestors of the Coniferæ (for which fossil plants afford ample evidence), and which still occurs in full development, along with the transfusion-tissue, in modern Cycads. But as, in the course of time, the centripetal xylem of the bundle, in the case of the Coniferæ, disappeared, as having become a useless tissue, the origin of the transfusion-tissue, which has persisted as a highly useful portion of the bundle, though still perceptible in Cycads, has, in the Coniferæ, become almost completely obscured.

Summary.

The chief points to be gathered from the investigation into the subject of this paper are the following:—

1. The universal presence of transfusion-tissue in the *leaves* of Gymnosperms whose venation is of a reduced or rudimentary character, and where the complex reticulate or dichotomous venation of the Ferns or the higher Angiosperms is lacking.
2. The conspicuous development of *centripetal xylem* in the vascular bundles of the foliage-leaves of all modern *Cycads*, without exception, where it constitutes the most important part of the xylem of the bundle. This is a point which has long been familiar to botanists.
3. The discovery, for the first time, of a *mesarch* structure of the vascular bundle in the leaves of Coniferæ. In the cotyledonary bundles of *Ginkgo biloba*, Linn., where this was first observed, the *centripetal* xylem forms the chief part of the woody strands and is very conspicuously developed. In the bundles of the cotyledons and mature leaves of all other Coniferæ which were examined the centripetal xylem is extremely reduced, this reduction having, in most cases, corresponded with a greater development of the *centrifugal* xylem. It is most obviously present in

those genera which approach nearest to *Ginkgo* in general relationship, such as *Cephalotaxus* and *Taxus*. In many genera, however, no trace of this tissue could by discovered, at least in the sections examined, though it is not improbable that isolated remnants of it may occur here and there along the course of the bundle through the leaf.

4. The occurrence, in the cotyledonary bundles of *Ginkgo biloba*, Linn., and *Cycas revoluta*, Thunb., of an intimate union and gradual transition between the tracheides of the centripetal xylem on the one hand and those of the transfusion-tissue on the other; whence it may be justly inferred that the latter tissue owes its origin, wherever it may subsequently be found, directly to the former. Though in the leaves of the majority of Coniferæ this origin is by this time almost entirely obscured, owing to the more or less complete obliteration of the centripetal xylem, it is still often evidenced by the presence of transfusion-tissue on the ventral side of the xylem, by the very frequent extension of the lateral transfusion-tissue *towards the ventral side of the bundle*, and by the transitions in the characters of the tracheides between those most externally placed and those nearest the protoxylem. In the foliage-leaves of *Cycas* the connection between the two tissues is obvious.
5. The final inference, that transfusion-tissue, which occurs almost universally in the leaves of Gymnospermous plants as an auxiliary conducting-system, has been phylogenetically derived from the centripetally-formed xylem of the vascular bundle, and is thus, morphologically, an integral portion of the bundle itself.

I am indebted to Mr. C. P. Robertson-Glasgow for the use of some excellent preparations of the cotyledons, leaves, &c., of various Coniferous plants. My best thanks are also due to Dr. D. H. Scott for many invaluable criticisms and much kind assistance during the progress of my work.

[The important discovery, quite recently made by the two Japanese botanists, Hirase and Ikeno, of spermatozoids in the pollen-tubes of *Cycas revoluta*, Thunb., and *Ginkgo biloba*, Linn., and still more recently by Webber in a species of *Zamia*, bridges over in a striking manner the gulf, hitherto supposed to exist between flowerless and flowering plants, between Ferns or Fern-like plants and Gymnosperms. The relation between the two great groups of plants had already been partly indicated by the Fern-like foliage of such a Cycad as *Stangeria*.

One of the most important of the facts brought forward in the present paper, viz. the occurrence of centripetal xylem in the cotyledonary bundles of both *Ginkgo biloba*, Linn., and *Cycas revoluta*, Thunb., seems to me (especially in view both of the external characters and anatomical structure of such fossil forms as the *Medulloseæ*, *Lyginodendron*, and *Næggerathia*) to strongly support the above conclusion that *Ginkgo* and the Cycads hold an intermediate position between some primitive group or groups of Fern-like plants and modern Gymnosperms.

1st October, 1897. W. C. W.]

EXPLANATION OF THE PLATES.

Plate XXIII.

Fig. 1. Two tracheides of typical Gymnospermous transfusion-tissue. × 390.

Fig. 2. Transverse section of a bundle from the pinna of *Cycas circinalis*, Linn., showing centripetal xylem and transfusion-tissue. × 130.

Fig. 3. Transverse section of a bundle from the cotyledon of *Ginkgo biloba*, Linn. × 390.

Fig. 4. Radial section of ditto. × 390.

Fig. 5. Transverse section of bundle from lamina of foliage-leaf of *Ginkgo biloba*, Linn. × 390.

Plate XXIV.

Fig. 6. Transverse section of bundle from petiole of foliage-leaf of *Ginkgo biloba*, Linn. × 130.

Fig. 7. Radial section of bundle from petiole of foliage-leaf of *Ginkgo biloba*, Linn. × 390.

Fig. 8. Transverse section of bundle from lamina of cotyledon of *Cycas revoluta*, Thunb. × 85.

Fig. 9. Transverse section of bundle from stalk of cotyledon of *Cycas revoluta*, Thunb. × 390.

Fig. 10. Radial section of bundle from lamina of cotyledon of *Cycas revoluta*, Thunb. × 390.

Fig. 11. Tangential section of portion of pinna adjoining the bundle of *Cycas circinalis*, Linn., showing the "accessory transfusion-tissue." × 130.

Plate XXV.

Fig. 12. Transverse section of bundle from pinna of *Ceratozamia mexicana*, Brongn. × 390.

Fig. 13. Transverse section of bundle from cotyledon of *Cephalotaxus drupacea*, Sieb. & Zucc. × 390.

Fig. 14. Radial section of bundle from cotyledon of *Cephatolaxus Fortuni*, Hook. × 390.

Fig. 15. Transverse section of bundle from leaf of *Taxus baccata*, Linn. × 390.

Fig. 16. Transverse section of leaf of *Podocarpus chilina*, Rich., showing accessory stone-cell tissue. × 85.

Plate XXVI.

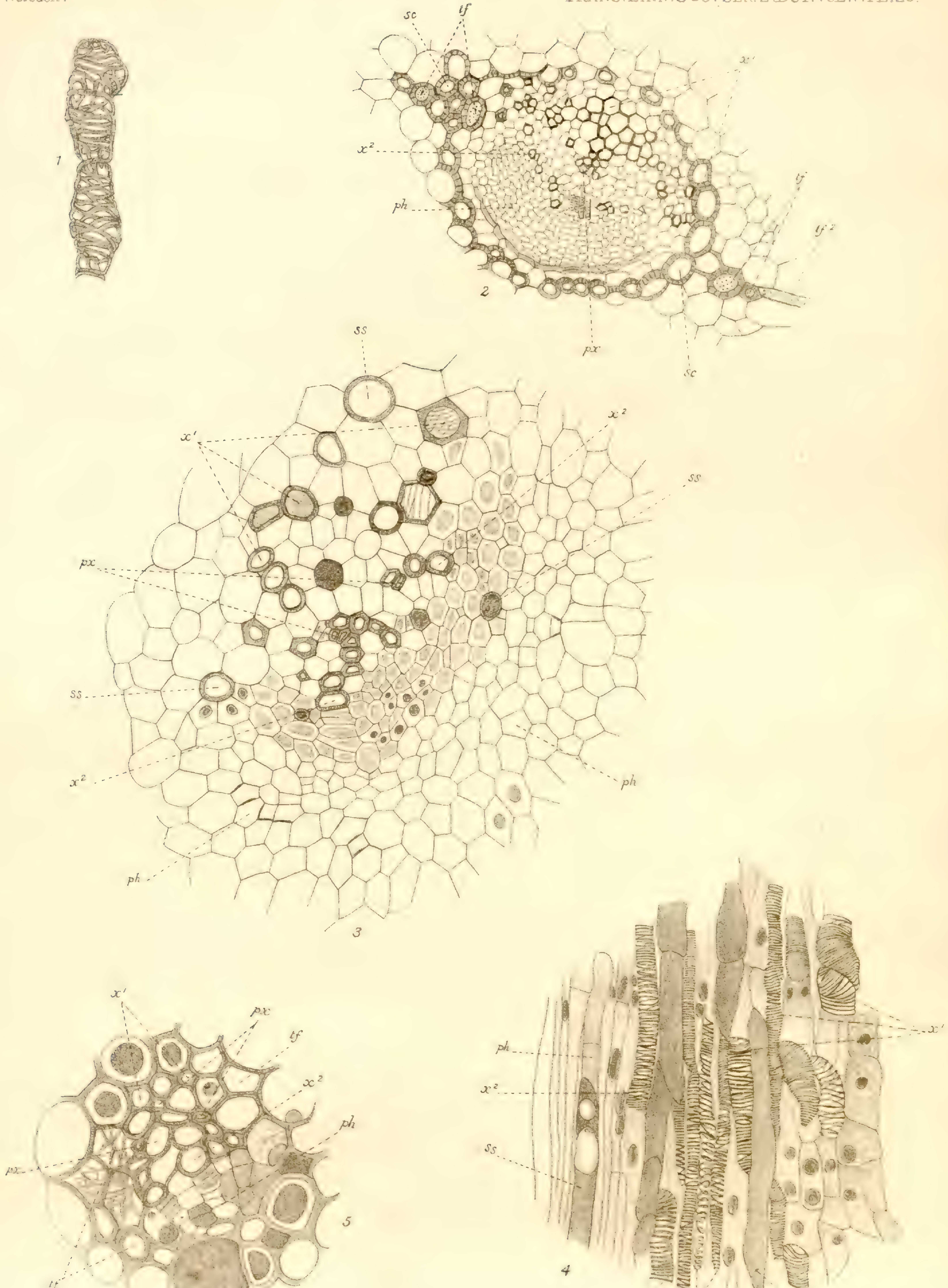
Fig. 17. Radial section of bundle from cotyledon of *Araucaria excelsa*, R. Br. × 390.

Fig. 18. Transverse section of bundle from leaf of *Araucaria imbricata*, Pav. × 390.

Fig. 19. Transverse section of bundle from leaf of *Dammara* sp. × 390.

Fig. 20. Radial section of ditto, and two tracheides of transfusion-tissue from the side of the bundle. × 390.

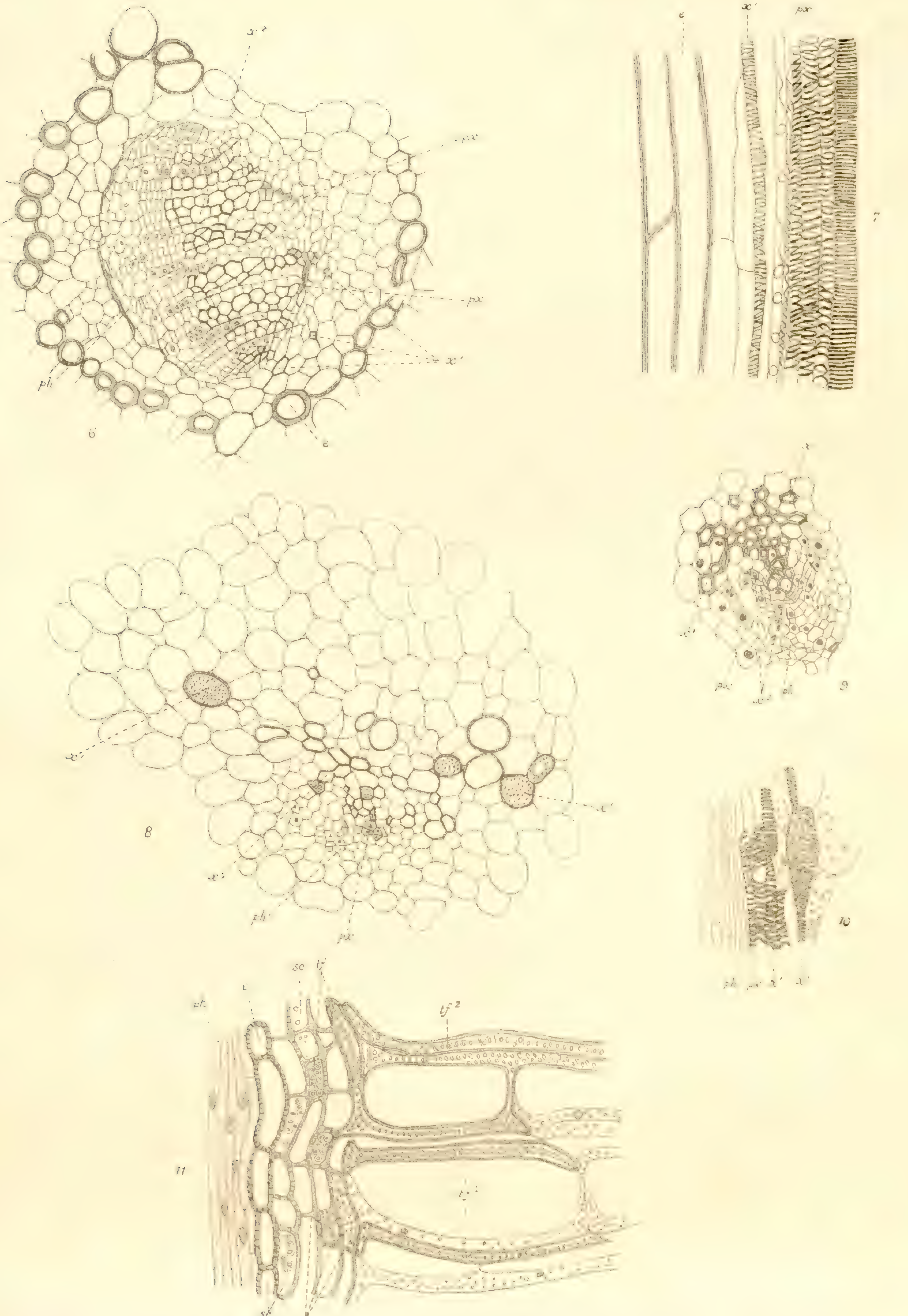
Fig. 21. Radial section of leaf of *Pinus Pinaster*, Soland. × 390.



W.C.W. del.

J.N. Fitch lith & imp.

GYMNOSPERMOUS TRANSFUSION TISSUE.



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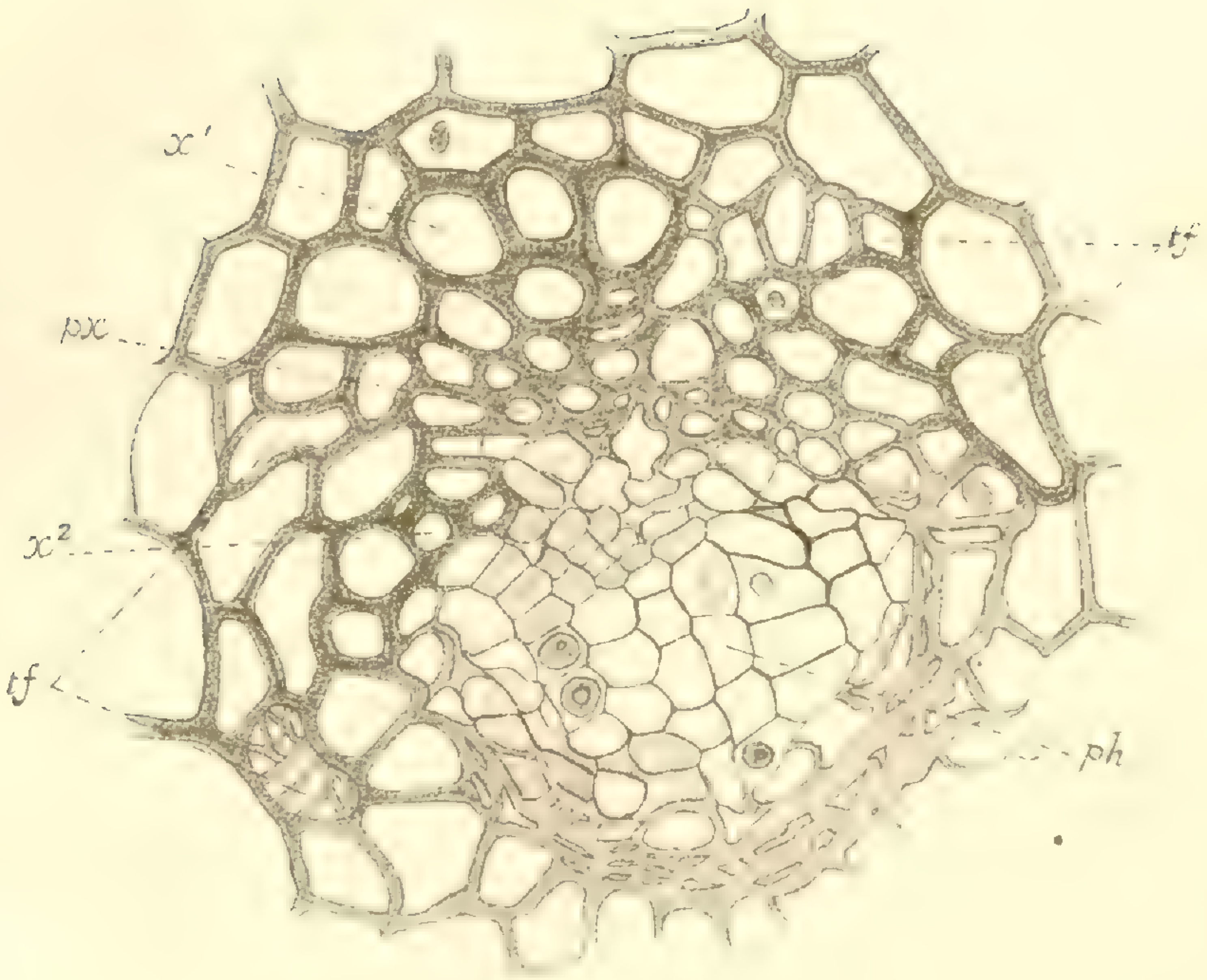

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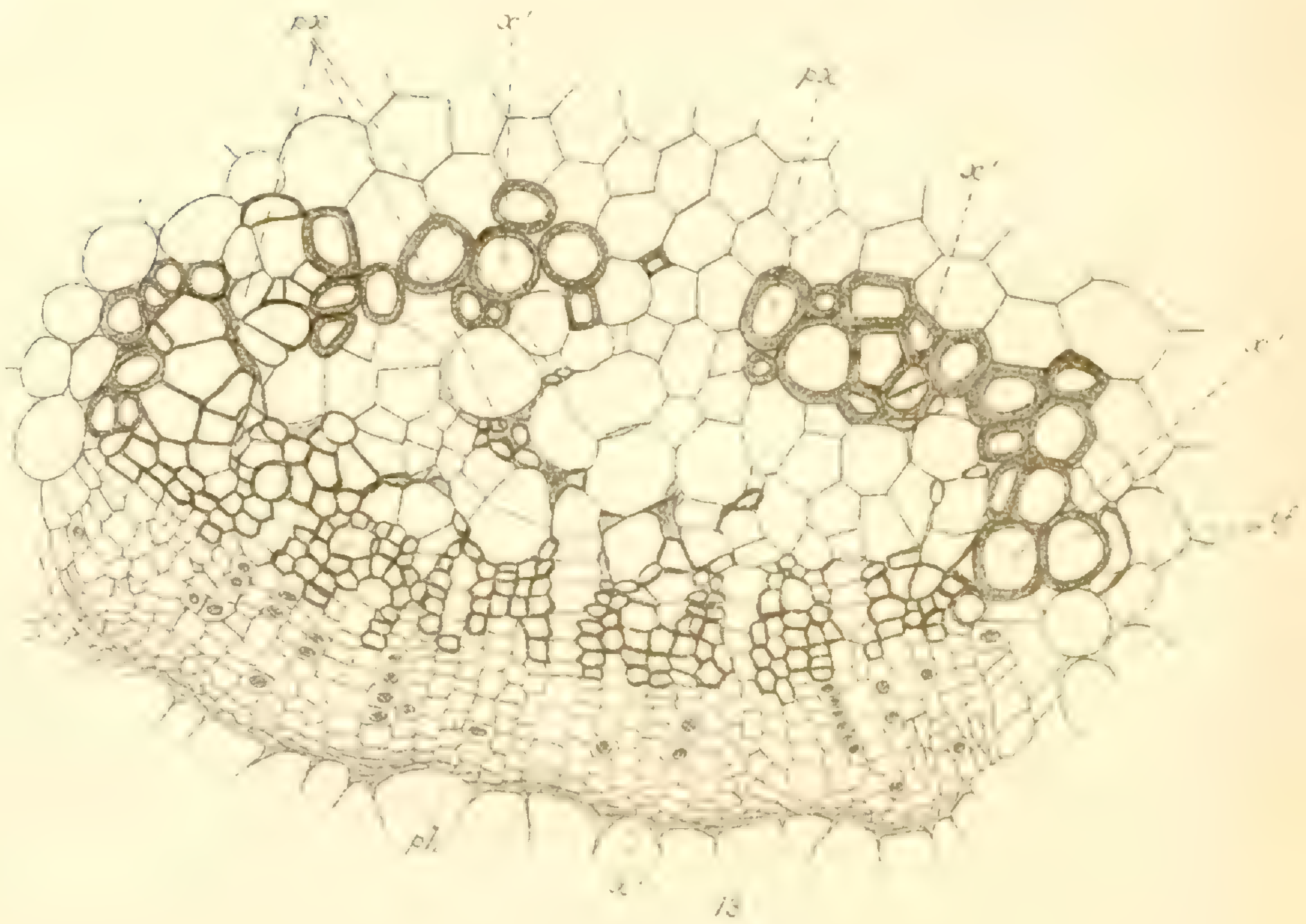

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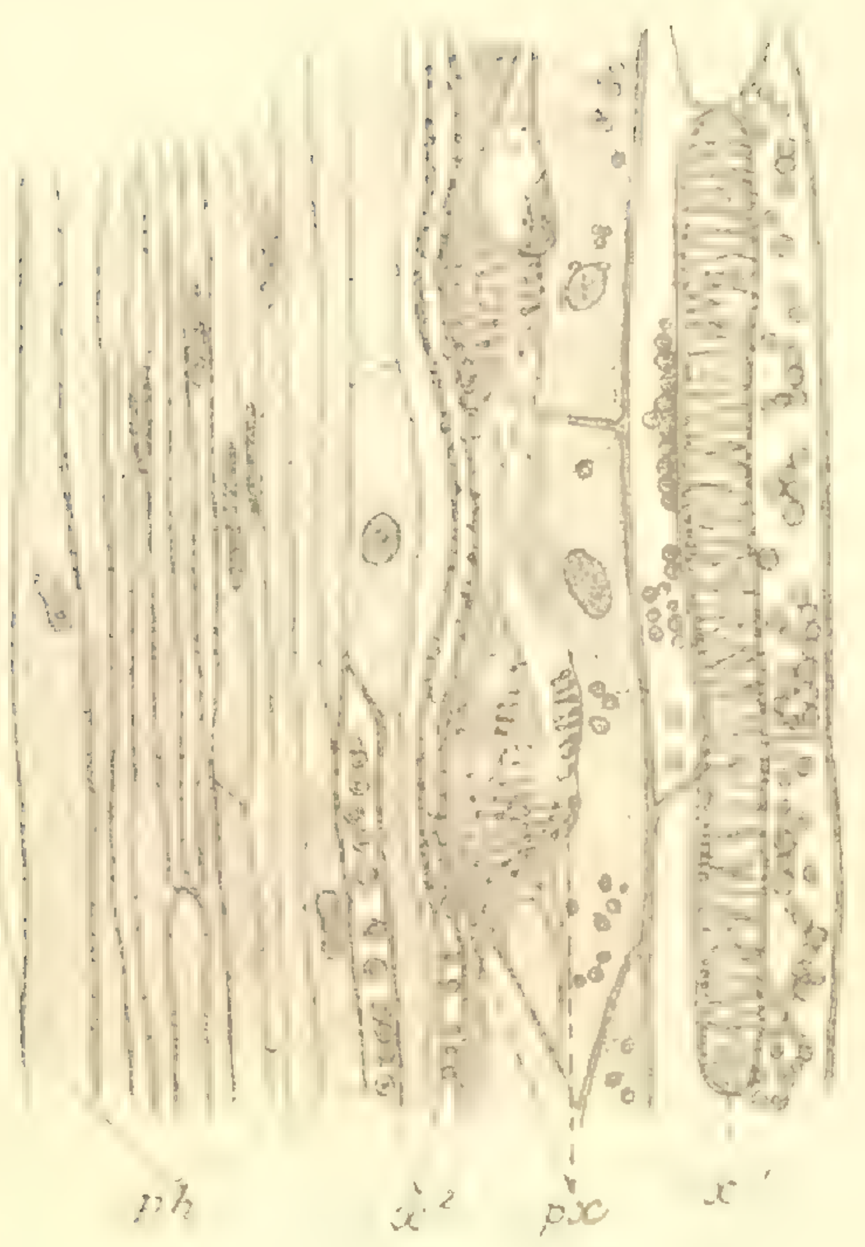

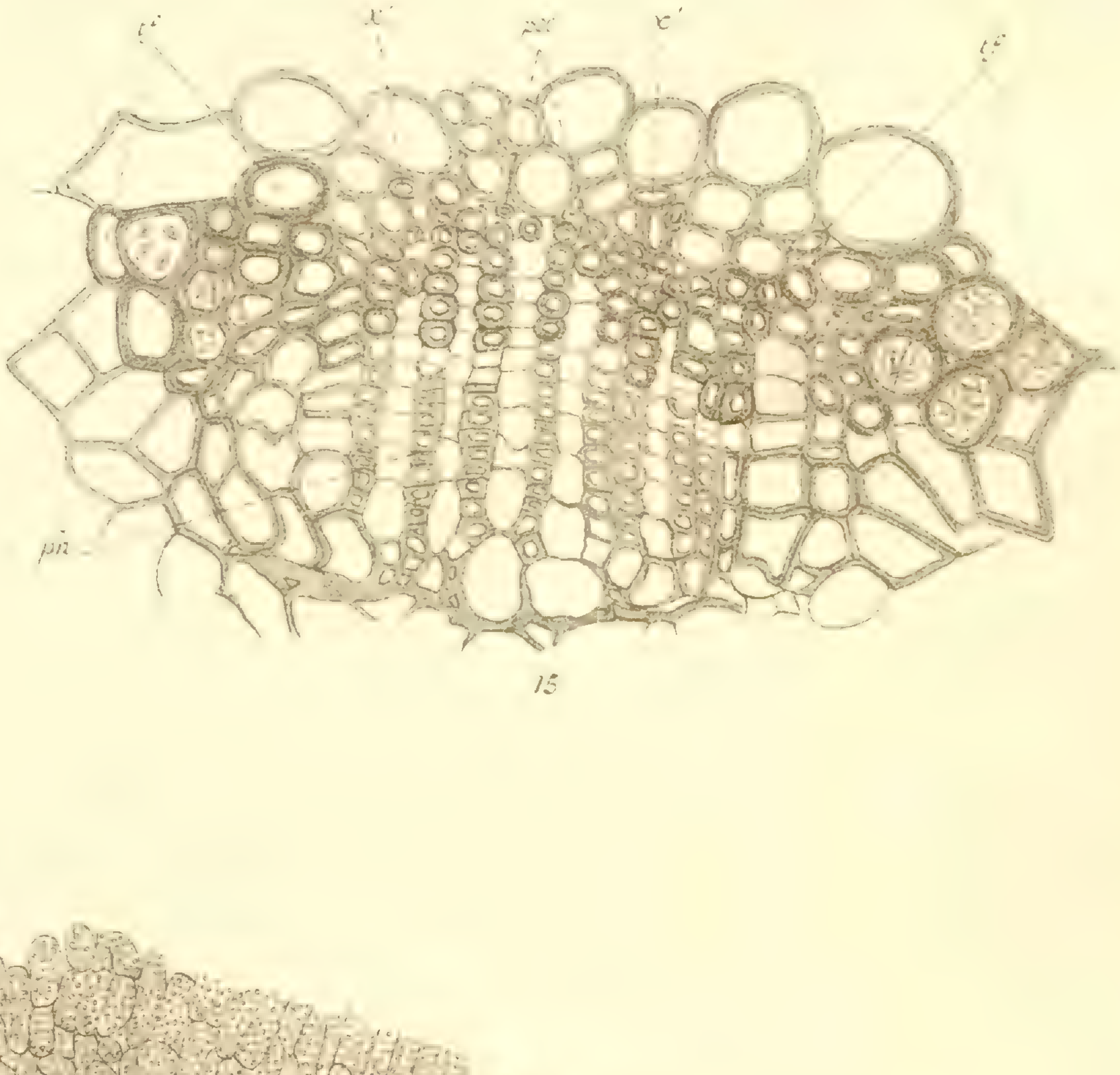

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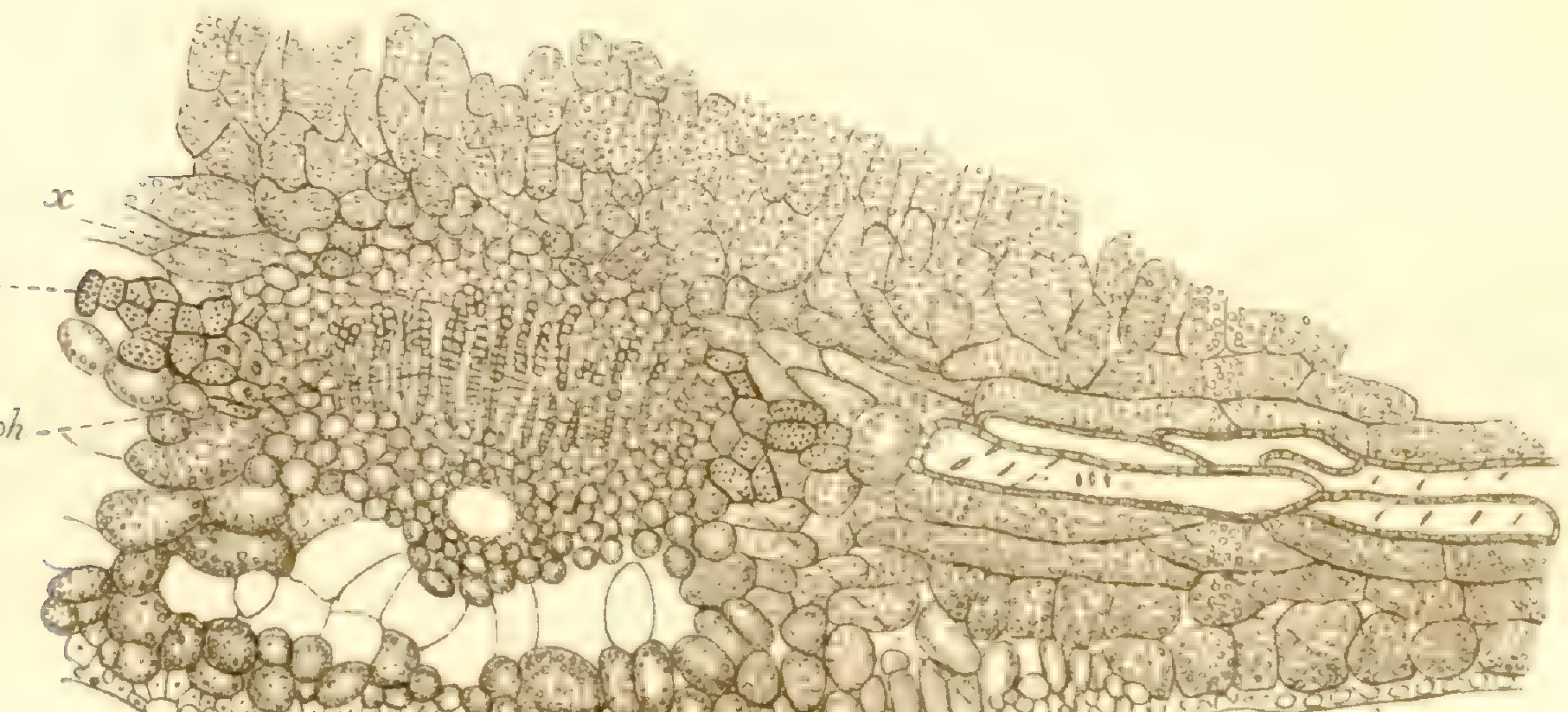

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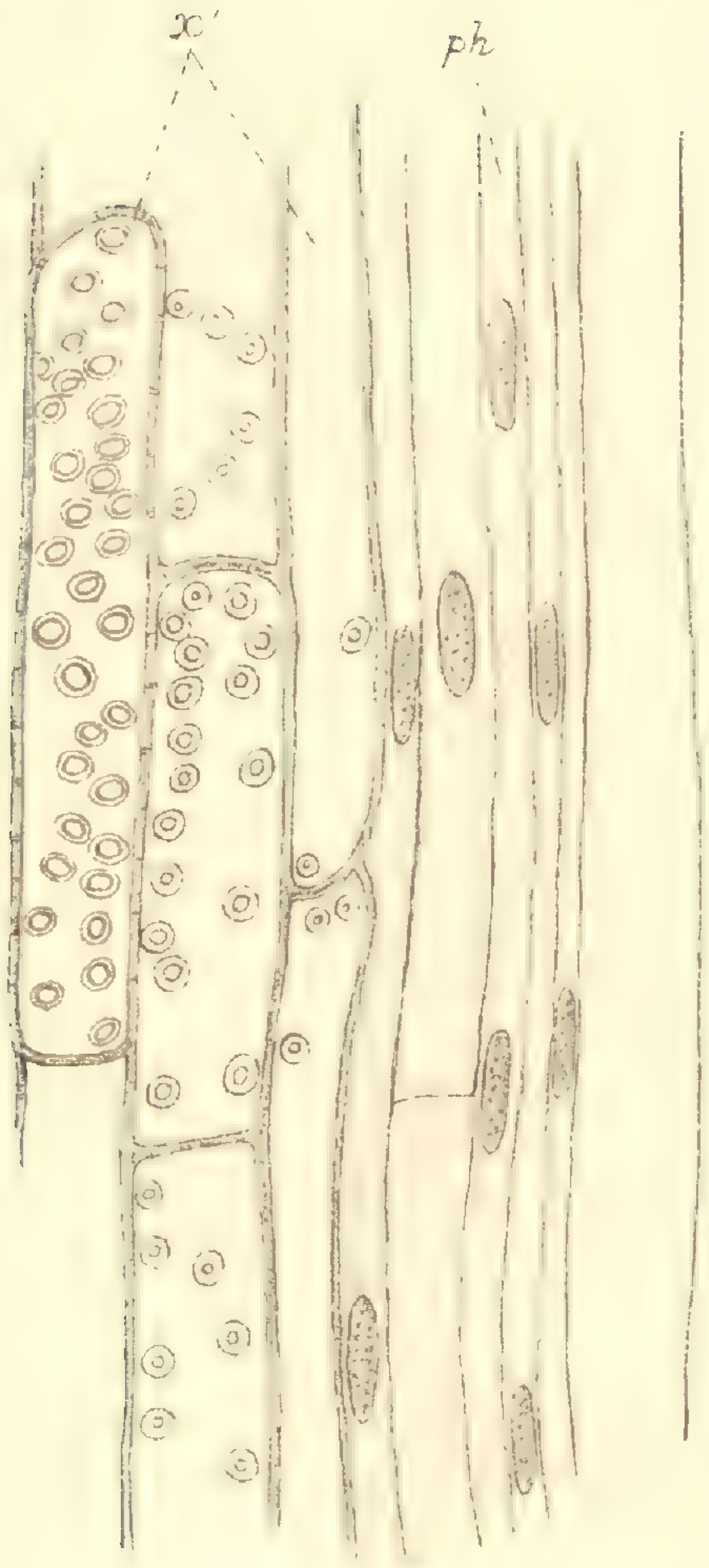

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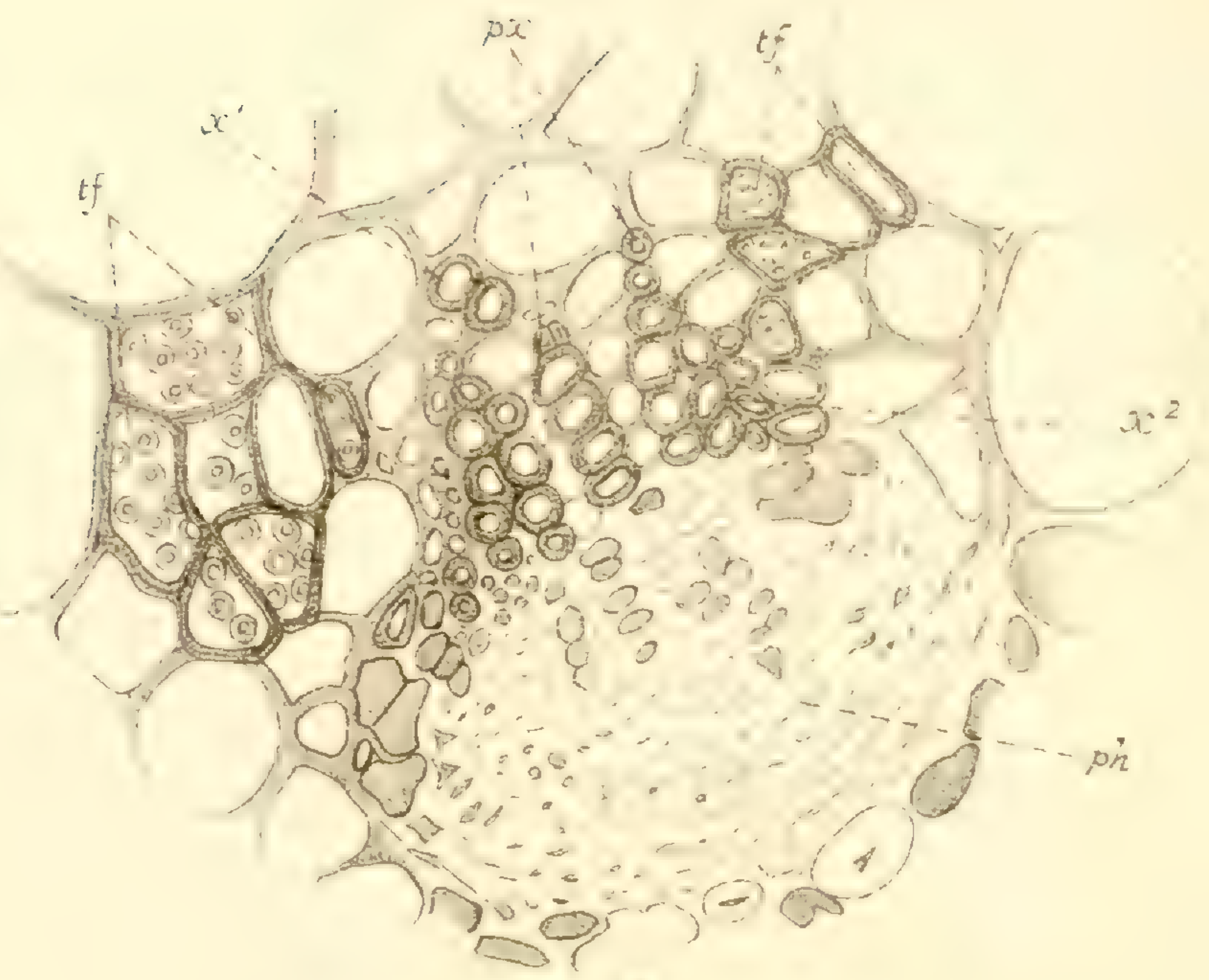

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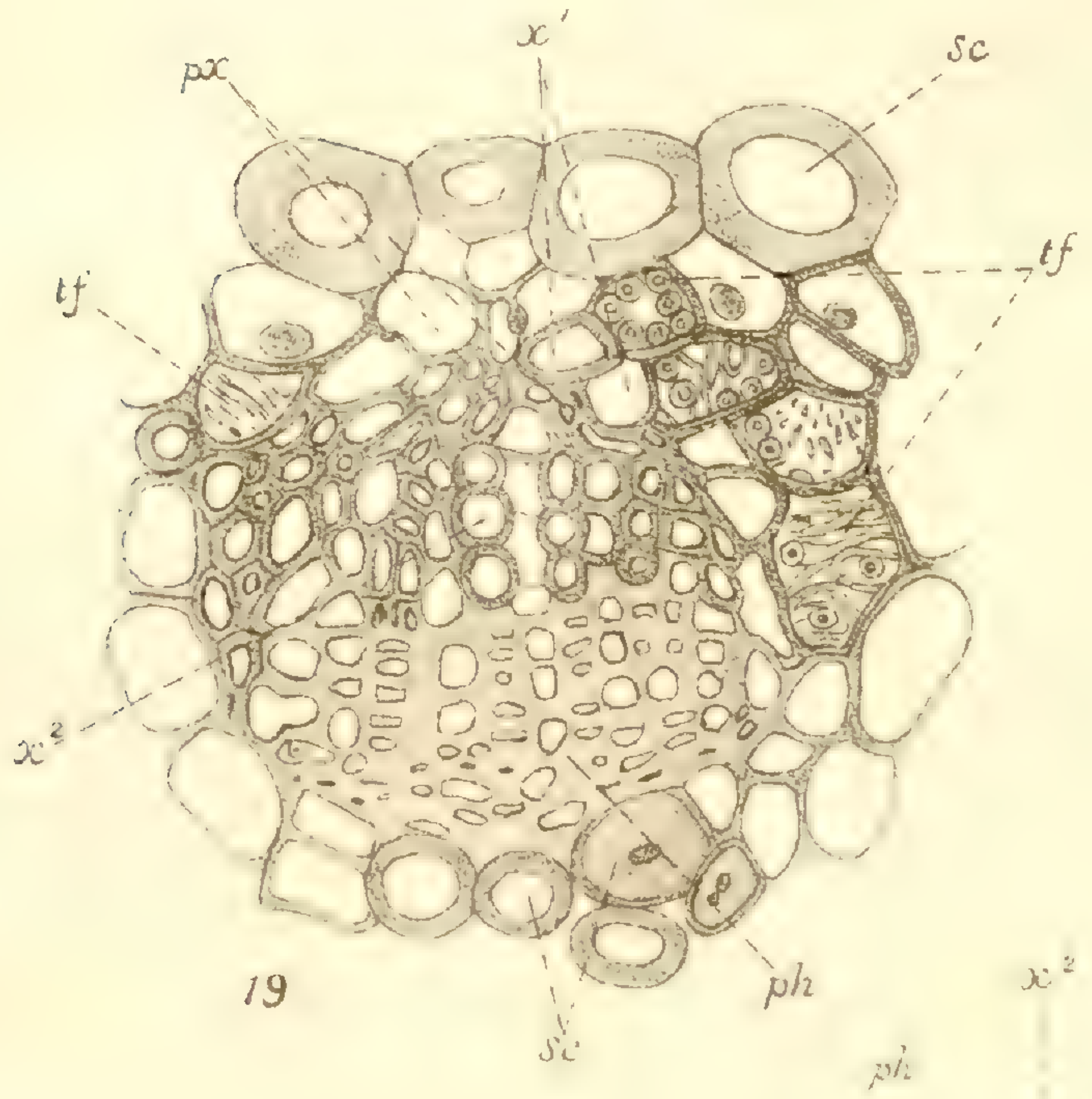

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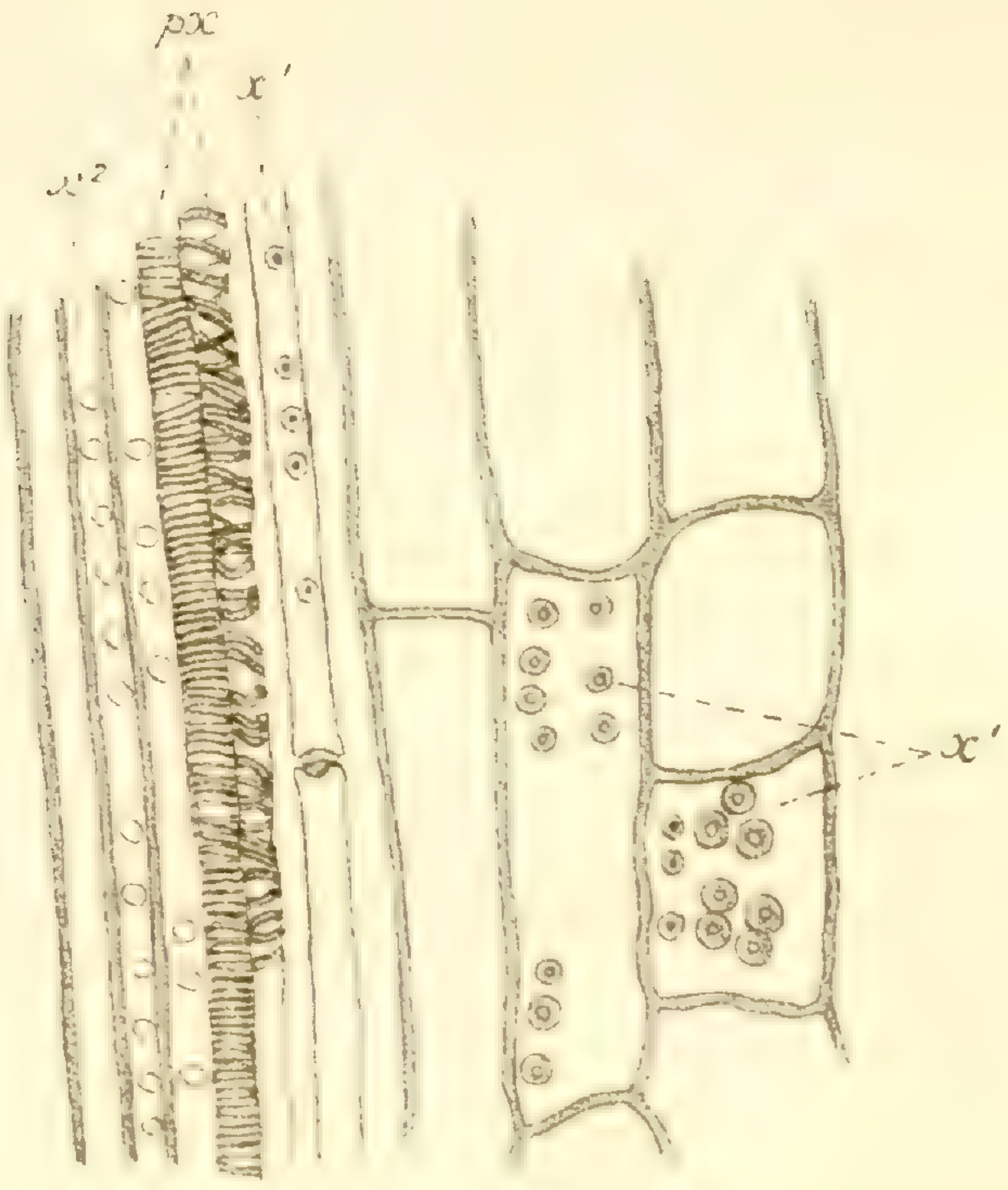

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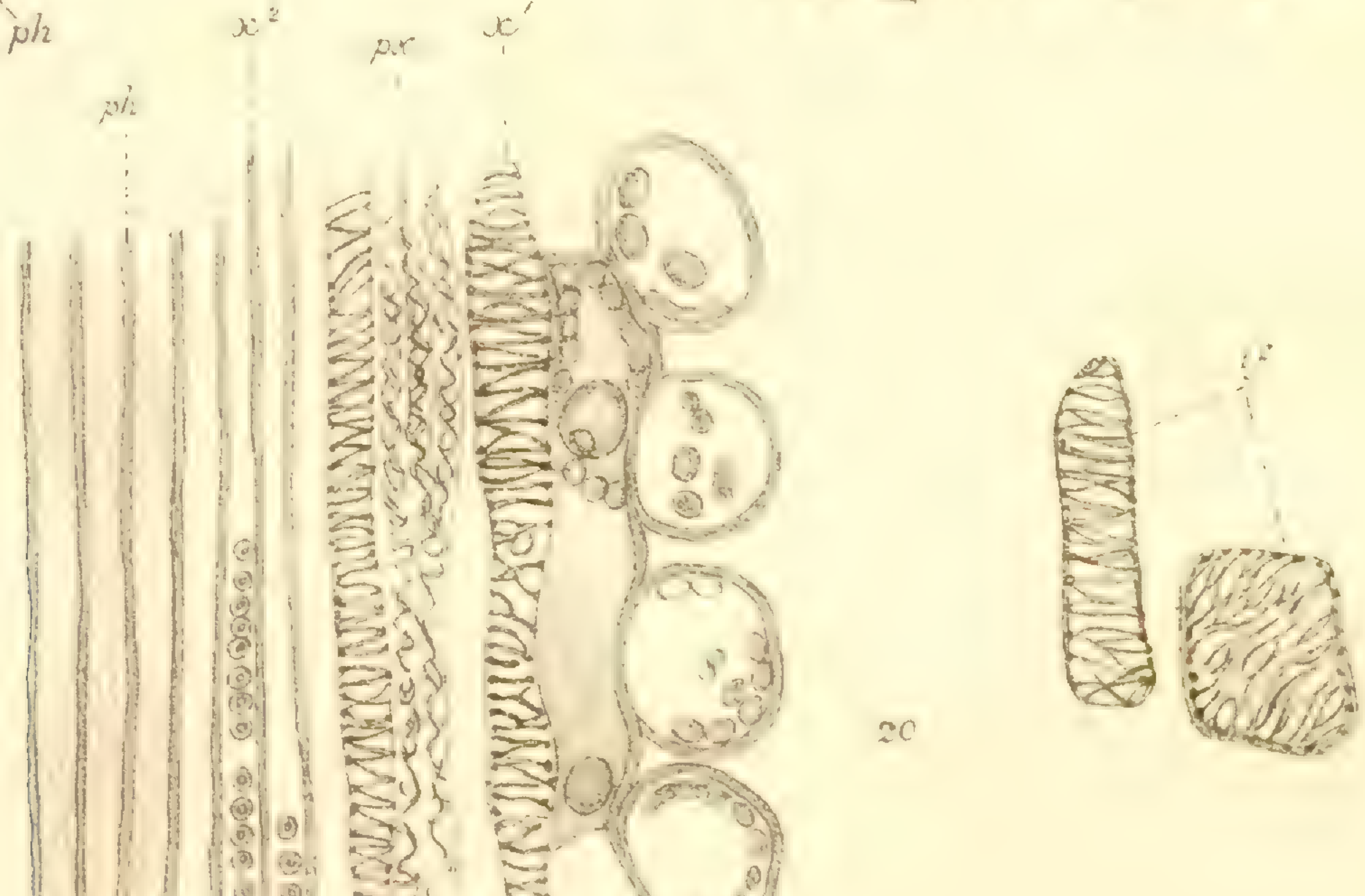

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GYMNOSPERMOUS TRANSFUSION TISSUE.

LINNEAN SOCIETY OF LONDON.

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	Part IV.	1896	1 0 0	0 15 0
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2nd Ser. BOTANY.] [VOL. V. PART 9.]

THE

TRANSACTIONS

OF

THE LINNEAN SOCIETY OF LONDON.

NEW PERIDINIACEÆ FROM THE ATLANTIC.

BY

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AND

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February 1899.

IX. *New* Peridiniaceæ *from the Atlantic. By* GEORGE MURRAY, *F.R.S., F.L.S., Keeper of Botany, British Museum, and* FRANCES G. WHITTING, *former Student of Newnham College, Cambridge.*

(Plates XXVII.–XXXIII.)

Read 19th January, 1899.

THE material described in the following paper was collected by Messrs. Murray and Blackman, during a voyage made in R.M.S. 'Para' (June, July, and August 1897), while engaged in a study of the Coccospheres and Rhabdospheres, and other forms of Phyto-plankton described elsewhere. Previous to this voyage in the 'Para,' and subsequently in the 'Medway' and 'Atrato,' Captain W. Haultain Milner (by the pumping method, employed in all cases cited here) has collected with the greatest success, while other collections have been contributed by Capt. Rudge on the 'Avon,' Capt. Tindall on the 'Elbe,' and Capt. Alex. Turbyne, while a passenger to the Cape on the 'Dunvegan Castle.'

Almost the whole of our previous systematic knowledge of the marine Peridiniaceæ is derived from Stein's 'Infusionsthiere' and Schütt's 'Peridiniaceæ' in the 'Ergebnisse der Plankton Expedition der Humboldt-Stiftung,' these writers having included in their treatment observations of older workers such as Ehrenberg. Stein, however, gives no formal diagnoses of genera and species, though his excellent figures clearly indicate the characters of his forms. Schütt also reserves such diagnoses for a future volume, contenting himself with a morphological exposition of the group, and with figures of his new and other species in the book cited and in his 'Pflanzenleben der Hochsee.' He has supplemented his text and figures, however, by giving the characters of the genera in his 'Peridiniales,' in Engler and Prantl's 'Natürlichen Pflanzenfamilien.' Even then, we have been compelled to represent here a few of his species for greater accuracy in certain details.

As yet no one has shown an example of the description of specific characters. In writing these for the present memoir we have found many difficulties, and the chief of these, in spite of Schütt's work, was the determination of what should be generic and what specific characters. In consideration of the fact that we are as yet merely at the beginning of the systematic study of marine Peridiniaceæ, and that the exploration of great tracts of ocean has yet to be undertaken with doubtless many new forms to be revealed, we have decided that it would lead to less eventual confusion if we included characters that at present look like generic characters among the specific. We have done so deliberately in a few cases, having been warned by our experience in the modification of the generic character by the addition of the new species we here describe. It is clear that there are already too many genera, and farther exploration may be

anticipated to confirm this view. For this first attempt at giving specific characters, then, we beg indulgent criticism.

But it may be said that we should first justify our inclusion of the Peridiniaceæ among Phyto-plankton. It is no new step, such workers at Plankton as Cleve and Schütt having done it before us. Whether these Dino-Flagellata be reckoned plants or animals —and in the absence of any absolute criterion we do not presume to assign them definitely to either group—they appear to form much the largest ingredient in the great mass of oceanic vegetation away from coastal waters, and in any study of the balance of animal and plant life in the sea their weight is a solid one in the scale. The argument is a purely physiological one, and is open to the criticism that the Peridiniaceæ may yet be animals effecting for themselves by their own intrinsic chromatophores what the Radiolaria, for example, accomplish by symbiosis with their yellow algal cells. However, this is not the occasion for a discussion of the question, nor does the present limited knowledge of the group justify any definite decision. We have found this form of vegetation predominant on the high seas, and we venture to describe it.

In some of the names assigned to new species we have commemorated the services of Captains Milner and Rudge, Messrs. Jolliffe and Hindmarch, the officers of ships who have done so much in gathering in our material, and Mr. Blackman, who accompanied Mr. Murray on one of the voyages, and to whose judgment we are indebted.

It was one of our objects to endeavour to discover from examination of the tables, drawn up to give the results of each voyage, some evidence of seasonal change. With a seasonal variation of temperature amounting to 5° Fahr. as far south as lat. 18° N., and of course a considerably greater variation farther north, some seasonal change in the Plankton seems inevitable. After a series of comparisons we have come to the conclusion that from the imperfections of the record on some of the voyages, especially those at lowest temperature, we would not yet be justified in stating general results. It will need a much longer series of records to establish any such results.

PTYCHODISCEÆ.

Ptychodiscus, Stein.

The only known species, *P. Noctiluca*, Stein, occurs very erratically in our records from lat. 39° N. to lat. 14° S., sometimes very abundant, oftener altogether wanting. We have figured it on Pl. XXVII. figs. 5 *a*, *b*, in order to show its girdle view, which is lenticular in outline.

P. Noctiluca, var. *fimbriatus*. This new variety differs from the typical form in having both projecting margins of the girdle fimbriate (Pl. XXVII. fig. 5 *c*). It was obtained by Capt. Turbyne in lat. 41° 30′ N., long. 11° 10′ W.

GLENODINIEÆ.

Glenodinium, Ehrenb.

G. trochoideum, Stein, recorded previously from Kiel haven, occurred once only in our collection (lat. 33° 20′ N., long. 43° 9′ W.).

CERATIEÆ.

CERATIUM, Schrank.

The species of this well-marked genus were present in every observation except two. *C. Tripos*, a species subdivided by some authorities, was present, in one form or other, in almost every gathering throughout the year from home waters to Colon, and is equally steady in the single series of observations down the coast of Brazil. *C. Furca*, *C. Furca*, var. *baltica*, *C. Fusus*, and *C. Candelabrum* appear throughout the records. *C. Limulus* ranges from the Equator to about lat. 41° N., so far as our gatherings show its distribution. *C. gravidum*, a rarer species, and one of quite aberrant form, has much the same range as *C. Limulus*, reaching lat. 38° N. *C. digitatum* occurred twice only, viz., in lat. 16° to 17° N., long. 68° to 69° W. A very distinct new species, which we have named *C. biconicum*, occurred only once in lat. 35° 20′ N., long. 37° 20′ W.

C. BICONICUM, sp. n. Body divided into two nearly equal limbs, widest at the girdle, each limb conical in shape, and the whole (including girdle) covered with fine punctate markings, streaks free from markings running lengthwise; ends of girdle slightly oblique; distal limb blunt at apex, proximal limb acuminate with irregular elongate foraminal area, and a thin membranous projecting flange near the foramen. (Pl. XXVII. figs. 4 *a*, *b*, *c*.)

The nearest ally of this species is clearly *C. Fusus*, which is much more elongate and thinner in proportion, and possesses a trace of a third limb near the girdle. There is no definite appearance of separate plates in the structure of the limbs or girdle. But for its resemblance to *C. Fusus* there would have been a difficulty in assigning *C. biconicum* to this genus, of which it is decidedly the simplest of its varied forms.

The variations in the species of *Ceratium* are noteworthy from the fact that it would be almost possible to demonstrate a linear series of forms connecting *C. biconicum*, through *C. Fusus*, *C. Furca*, *C. Candelabrum*, and *C. Tripos*, with *C. Limulus*; *C. digitatum* and *C. gravidum* being divergent.

GONYAULAX, Dies.

Gonyaulax birostris and *G. polygramma* appear from our records to have a fairly wide distribution in the Atlantic, the latter ranging from lat. 4° N. to lat. 42° N., and the former being both tropical and temperate. Stein gives both as coming from the "South Sea." In addition to these species we have observed three others, all new.

G. TURBYNEI, sp. n. Body approximately ovate, divided into two nearly equal limbs by the girdle, all its plates covered with punctate markings; proximal limb composed of one row of numerous narrow, elongate, mostly four-sided plates, the arrangement of the plates irregular in the region of the foramen; distal limb composed of two rows of similar plates, those adjacent to the girdle being much larger than the others. (Pl. XXVIII. figs. 4 *a*, *b*.)

It ranges from lat. 16° 54′ S., long. 2° 54′ E., to 47° N. by 13° W., and to long. 72° W. in 16° and 17° N. lat.

GONYAULAX JOLLIFFEI, sp. n. Body divided into two nearly equal limbs, widest at the girdle, ends of girdle oblique; the membrane, including girdle, composed of angular plates covered with fine punctate markings; the proximal limb tapering abruptly, acuminate, apex consisting of a single conical plate; the distal limb very deeply trifid. (Plate XXVIII. figs. 1 *a*, *b*.)

Its nearest ally is evidently *G. polygramma*, as figured by Stein, though its plates approximate to those of *G. birostris* ('Infusionsthiere,' Abth. iii. plate iv. figs. 16 & 20). Its range is from the Azores to Panama.

G. HIGHLEII, sp. n. Body divided into two approximately equal limbs, widest at the girdle; membrane composed of angular plates, finely punctate; girdle punctate, and ends of same oblique; proximal limb rounded below, tapering above, drawn out into a long unmarked spine which is enveloped in a sheath; foraminal area irregularly oval; distal end armed with two long sheathed spines, which are finely marked for two thirds of their length. (Pl. XXVIII. figs. 2 *a*, *b*.)

Its range is the same as *G. Jolliffei*, though it has not been traced quite so far north.

G. GLYPTORHYNCHUS, sp. n. Body divided into two nearly equal limbs, widest at the girdle; membrane composed of angular plates, faintly punctate; girdle unmarked and with prominent margins, ends oblique; proximal limb conical, but slightly rounded, terminating in a spine marked with two lateral bands of oblique striæ; foraminal area irregularly oval; distal limb armed with two, sometimes three blunt spines, marked externally with exactly transverse striæ. (Pl. XXVIII. figs. 3 *a*, *b*, *c*.)

In the sea between Barbadoes and the Azores (between lat. 18° N., long. 52° W., and lat. 24° N., long. 51° W.

GONIODOMA, Stein.

It will be seen from an inspection of the Tables that *G. acuminatum*, Stein, the only species known hitherto, occurs with great regularity in all the waters traversed. For example, in the Table of 'Para,' Voyage III., we miss it only in three gatherings. In the voyages of the 'Medway' and 'Atrato,' late in the season, it drops out from certain gatherings, and it might appear that we have here an indication of some seasonal change. That this is improbable appears from the fact that we miss it only in tropical waters where there is comparatively little fluctuation of temperature; and in the 'Para' Voyage I. (February–March) it drops out from the record only twice. Moreover, it shares this absence from the 'Medway' gatherings with a number of other common forms such as *Peridinium divergens*, thus pointing to some casual imperfection in the mode of collecting. We have added the following three new species:—

GONIODOMA MILNERI, sp. n. Body unequally divided by the girdle; membrane, including that of girdle, finely punctate; proximal limb the smaller, dome-shaped, but the upper plates forming a projection, the lower plates broad at their bases where they join the girdle, narrowing upward; foraminal area irregularly elongate; distal limb box-shaped, the sides composed of six plates, four of them nearly square, two oblong and a flat bottom, with short spines projecting downward at the junctions of the plates and at the ends of the girdle. (Pl. XXVII. figs. 2 *a*, *b*, *c*, *d*.)

Figs. 2 *a*, *b* represent the typical form of *G. Milneri*. Figs. 2 *c*, *d*, representing another form (one encysted), are noteworthy as showing the body divided into more equal halves, this equality being attained by a narrowing downward of the distal limb. The divergence of this form is so great and so fixed as almost to entitle it to specific rank. The species differs from *G. acuminatum* mainly in the typical unequal division of the body and its shape, the projection on the proximal limb, and in the possession of spines. In this last respect it is approached by *G. acuminatum*, var. *armatum*, Schütt. Its range is from the Azores to the Caribbean Sea.

G. FIMBRIATUM, sp. n. Body divided into two limbs almost equal in bulk but of different shapes; membrane finely punctate; girdle projecting at both margins as a fine membrane with a row of acute tooth-like supports; proximal limb narrowing towards the flat base, armed with short spines at the junctions of the plates; distal limb dome-shaped, composed of six plates, broad at the base, narrowing upward, where they join an apical six-sided area. (Pl. XXVII. figs. 1 *a*, *b*.)

Its range, so far as we can tell at present, is between lat. 40° N., long. 29° W., and lat. 14 N., long. 71° to 76° W.

G. SPHÆRICUM, sp. n. Body spherical and symmetrically divided by the girdle; margins of girdle prominent and unmarked; six plates of distal limb broad at the base where they meet the girdle, narrowing above and converging towards the square, arched, apical plate; the plates of proximal limb nearly the same in shape and arrangement, but differing slightly owing to the presence of the foraminal area; an apical pore present on the proximal plate. (Pl. XXVII. figs. 3 *a*, *b*.)

This species is at once distinguished from the others by its spherical shape, though the arrangement of its plates proclaims it a true *Goniodoma*. So far as our records show, its distribution is very limited, viz. from lat. 35° N., long. 29° W., to lat. 27° N., long. 41° W.

DIPLOPSALIS, Bergh.

Diplopsalis Lenticula, Bergh, the only species hitherto known, appears only once in our record, viz. in lat. 25° 41′ N., long. 49° 31′ W. A new species, of very distinct aspect, appeared in our captures of 22nd June, the day of Her Majesty's Jubilee, and in commemoration of the fact we have named it

D. SÆCULARIS, sp. n. Body in the girdle-view an irregular ellipse, divided by the girdle into fairly equal limbs; girdle fimbriate on both margins, with the ends widely oblique; proximal limb composed of irregular four-sided plates, each with a few

scattered punctate markings, two fine spines and a few shorter ones by foraminal area; distal limb composed of one large, somewhat crescent-shaped, apical plate, and other smaller ones bordering the girdle, mostly unmarked, two of them on the ventral side depressed, with the one between them punctate. (Pl. XXVIII. figs. 5 *a*, *b*.)

Figs. 5 *c*, *d*, *e* represent a variety with dome-shaped limbs, almost spherical in general outline; and fig. 5 *f* another variety, in which two horn-like projections take the place of the spines near the foramen.

The whole body of *D. sæcularis* has a very delicate and fragile look, and appears translucent from the faintness and fewness of the fine markings. Its range is from lat. 37° N., *i. e.* a little south of the Azores, to the Isthmus of Panama.

Peridinium, Ehrenb.

P. divergens, Ehrenb., like *Goniodoma acuminatum* and *Ceratium Tripos*, has an almost universal record in all our gatherings. Constant though its occurrence was, it was by no means regular in form. The variations in form were such that it is difficult to believe that one species embraces them all. However, they did not occur mixed to any great extent in the gatherings, but mostly one at a time, and in any case always one form predominant, which seems to point to their being not separate species but local varieties. In the voyage of the 'Avon,' Capt. Rudge evidently passed through a shoal of *P. divergens* about 24 hours' steaming from soundings, and in the next gathering but one, when just inside soundings, there was only one *P. divergens* observed, and in place of this species a shoal of *Halosphæra viridis*. The figures (in Pl. XXIX. figs. 4 *a*, *b*) show, in the larger one, an extreme form of *P. divergens* with its contents, and in the other a form near it. *P. Michaelis* has a wide range like *P. divergens*, but occurs much more sparsely. *P. Globulus* also has a wide distribution, ranging from lat. 6° S. to lat. 44° N. in the Atlantic. *P. tristylum* occurs sparingly from the Azores to Panama. We have noted the following new species:—

P. Hindmarchii, sp. n. Body divided into two almost equal limbs by the girdle, uniformly covered with large 4–5-sided areolæ; girdle similarly marked with one row; ends of girdle very slightly oblique; foraminal area furrowed, elongate, extending into distal limb; proximal limb widely bifurcate; distal limb bluntly conical. (Pl. XXIX. figs. 1 *a*, *b*.)

In *P. Hindmarchii* and in the following species there is no apparent plate-structure, and we assume that the indications of its existence are obliterated by the large areolæ which cover the whole body. The species occurs from about lat. 34° N., long. 39° W., to Panama, but never abundantly.

P. leiorhynchum, sp. n. Body divided into two approximately equal limbs by the girdle; girdle at one end broad, areolate, and very much narrowed at the other end and without markings; proximal limb composed of irregular plates bordering the

girdle, widely bifurcate, the bifurcations each terminating in an acute spine, with a few minute projections round the foramen; distal limb bluntly conical, partially areolate. (Pl. XXIX. figs. 2 *a*, *b*.)

It occurs in latitudes between 20° and 40° N. and longitudes 30° to 50° W.

Peridinium Milneri, sp. n. Body unequally divided at the girdle; girdle areolate, with very oblique ends; proximal limb composed of mostly 4-sided plates, with broad, clear, unmarked margins, the areolæ being of irregular shape and size and strongly marked, with projections at the extremity; distal limb lid-like, irregularly areolate. (Pl. XXIX. figs. 3 *a*, *b*.)

It occurs in lat. 29° to 31° N., long. 42° to 44° W.

P. Tripos, sp. n. Body widest at the girdle; girdle composed of a single row of large areolæ, ends oblique; proximal limb marked with rows of large areolæ, with three short acute spines at the extremity, foraminal area elongate; distal limb the smaller, areolate, with three short projections at the apex. (Pl. XXX. figs. 4 *a*, *b*.)

It occurs in latitudes from 31° to 14° N. and longitudes 38° to 58° W.

P. Doma, sp. n. Body widest at the girdle; girdle broader at one end, with 2–3 rows of areolæ, ends oblique; proximal limb composed of large plates irregularly arranged and areolate, foraminal area elongate, furrowed; distal limb dome-shaped, areolate, without distinct plate-structure. (Pl. XXX. fig. 3.)

It was obtained in lat. 34° to 39° N., long. 39° to 32° W.

P. vexans, sp. n. Body widest at the girdle, without apparent plate-structure, pitted all over, including girdle; ends of girdle oblique; proximal limb with two small projections near the extremity of the elongate foraminal area; distal limb bluntly conical. (Pl. XXIX. figs. 7 *a*, *b*.)

P. vexans was found in lat. 44° to 47° N., long. 19° to 13° W.

P. trirostre, sp. n. Body divided into two nearly equal limbs by the girdle, covered with large areolæ varying in size and form; girdle with one row of large areolæ bordered by two smaller rows, ends widely oblique; proximal limb trifurcate, foraminal area with unmarked projecting membrane; distal limb bluntly conical. (Pl. XXIX. fig. 5.)

It was found once only in lat. 25° 41′ N. and long. 49° 31′ W.

P. Blackmani, sp. n. Body equally divided at the girdle; girdle finely areolate, foraminal area in deep narrow furrows; proximal limb widely bifurcate at the extremity, with large four-sided plates bordering the girdle, clear and transparent, but marked with exceedingly delicate areolæ, beyond these plates the limb covered with strongly-marked oval areolæ to the ends of the bifurcations; distal limb conical, with clear plates bordering the girdle as in proximal limb, and beyond them strongly areolate to the apex. (Pl. XXIX. figs. 6 *a*, *b*, *c*.)

This very large and handsome *Peridinium* is of rare occurrence, but we record it from

the Caribbean Sea between Jamaica and Colon and from the Atlantic between lat. 25° N. and lat. 9° N.

PERIDINIUM SPHÆRICUM, sp. n. Body spherical and entirely free from markings, exactly divided into two equal limbs by the girdles; girdle unmarked, ends oblique; plates of both proximal and distal limbs mostly 5-sided, large, and distinct; foraminal area elongate, not depressed, foramen oval; distal limb with apical pore. (Pl. XXX. figs. 1 *a*, *b*.)

This species is closely related to *P. Globulus*, from which it differs in its larger plates and in the body and girdle being entirely free from the markings characteristic of *P. Globulus*. We have represented on Pl. XXX. figs. 2 *a*, *b*, an organism which occurred in one gathering only and puzzled us not a little. It has no discernible girdle, no markings on the plates, but in other respects, especially the shape of the plates and the markings at their junctions and the foraminal plate, it strongly recalls *P. Globulus*. *P. sphæricum* occurs in the Atlantic from lat. 44° N. to lat. 9° N.

P. SPINULOSUM, sp. n. Body ovate, unequally divided by the girdle, ends of girdle meeting exactly, the whole surface strongly areolated with short thick spines at the angles of the 4-sided areolæ; proximal limb larger than distal; foraminal area narrow. (Pl. XXIX. fig. 8.)

This minute species was found in one gathering, lat. 28° N., long. 40° W., in the voyage of the 'Atrato.' This species has a superficial resemblance to *Protoceratium reticulatum*.

PODOLAMPAS, Stein.

Podolampas bipes, Stein, and *P. palmipes*, Stein, occurred with very fair regularity over the region we have examined, but particularly from lat. 40° N. southward.

AMPHIDOMA, Stein.

Amphidoma Nucula, Stein, the only known species, occurred with great constancy throughout the region examined.

OXYTOXUM, Stein.

Oxytoxum Scolopax, Stein, and *O. constrictum*, Schütt, range from the Azores to the Equator in the Atlantic and to Panama in the Caribbean; *O. diploconus*, Stein, from the Azores to Panama; *O. tessellatum*, Schütt, from lat. 35° N. to lat. 14° N. *O. Gladiolus*, Stein, occurs only near the Azores in our gatherings, and *O. reticulatum*, Schütt, from the Azores to lat. 19° N. (Stein gives the Mediterranean as its home). On Pl. XXVII. fig. 7 we have figured *O. constrictum* to show its chromatophores. In addition to these species, we found another which must be recorded as new:—

O. MILNERI, sp. n. Body approximately spindle-shaped, unequally divided by the girdle; the whole membrane, except the girdle, finely punctate; girdle with one row of 4-sided areolæ; proximal limb acutely conical, composed of long, narrow, tapering

plates extending from the girdle to the apex ; apex elongate-acuminate ; distal limb short, bluntly conical, but terminating in an elongate-acuminate apex slightly out of the median line, composed of plates tapering from the girdle. (Pl. XXVII. fig. 6.)

Its distribution is from the Azores to Panama.

Ceratocorys, Stein.

Ceratocorys horrida, the only species known hitherto, is abundant south of lat. 35° N. to lat. 14° S. in the Atlantic and to Panama in the Caribbean. Stein gives it as from Polynesia. Now and then we came upon a variety of it figured on Pl. XXX. fig. 5 *a*, and an encysted state, fig. 5 *b*. The variety (or possibly new species) is distinguished by having its spines in one plane and by the slightly developed distal limb and girdle as seen in the figure.

In the gatherings of the 'Atrato,' lat. 32° N. and lat. 23°–24° N., we found what was undoubtedly the lid-like proximal limb of a *Ceratocorys* which we took to be new and gave it a provisional name. It is represented in Pl. XXX. fig. 6 *d*. In the 'Elbe' collections we found it again in lat. 2° N. and on the Line, the lids being smaller and plainly belonging to younger specimens (fig. 6 *c*). In spite of repeated search for the rest of the organism we had given it up, when fortunately one appeared at the last moment in a gathering from lat. 4°–6° S. We are thus able to give a description of this new species as

C. spinifera, sp. n. Body unequally divided by the girdle and marked with numerous small irregular pits over the plates; girdle marked by one row of rectangular areolæ, both margins projecting and acutely serrate, but with a fine membrane between the teeth, ends oblique; proximal limb the smaller, arched and lid-like, composed of four segmental plates with broad, thick, projecting ribs, honeycombed with pits at the junctions; foraminal area (with foramen at the apex of the limb) on the specially broad rib which runs down to the ends of the girdle, where it is depressed and continues as a furrow on the distal limb; distal limb much larger than the proximal, composed of 4 (?) plates with six large four-winged spines below, the outer wing decurrent from the girdle, each spine with a stout, central axis giving off to each wing a row of secondary branches near the extremity. (Pl. XXX. figs. 6 *a*, *b*, *c*, *d*).

Its distribution is from lat. 28° N. to lat. 6° S. and evidently very rare, since we have met with it only five times, and in a complete state only once. Its main points of difference from *C. horrida* may be summarized as the arched lid with its broad, projecting, honeycombed ribs, its acutely serrate girdle, and its broader and shorter spines.

On Pl. XXX. fig. 6 *e* there is represented either a younger state of this species in which only two spines have appeared, or a variety with two spines. The whole organism is smaller than typical *C. spinifera*, which favours the former view; on the other hand, its two spines appear to be as well-developed as the six spines of the type.

A comparison of the magnifications of the figures suggests either a great range in size of this species, or that the form figured (Pl. XXX. figs. 6 *a*, *b*) is not yet mature. Its magnification is ×840, while that of the proximal limb (fig. 6 *d*) is ×410, and it is only slightly larger in the figure.

DINOPHYSEÆ.

PHALACROMA, Stein.

Phalacroma operculatum, Stein, and *P. doryphorum*, Stein, occur pretty constantly over the whole region examined. *P. Mitra*, Schütt, not so abundant as these, occurs, however, over the region from the Azores to Panama. On Pl. XXXI. fig. 7 we have represented this species, since we are not satisfied with the author's presentment of some of its details in his 'Peridiniaceæ,' pl. 4. fig. 18. *P. Jourdani*, Schütt, occurred in one gathering in lat. 17° 58′ N., long. 53° 32′ W. *P. porodictyum*, Stein, also occurred in one collection, viz. in lat. 37° 44′ N., long. 30° 55′ W. *P. Globulus*, Schütt, occurs from lat. 35° N. to lat. 20° N., and *P. cuneus*, Schütt, was found once only in lat. 24° 9′ N., long. 52° 50′ W. Besides these we found four new species.

P. BLACKMANI, sp. n. Body divided into two unequal limbs by the girdle, nearly ovate, covered all over (including girdle) with large, well-marked, 4–5-sided areolæ; girdle projecting at both margins as a fine membrane with a row of acute tooth-like supports; proximal limb the larger, composed of two plates, with sail decurrent nearly its whole length, supported by three short spines; plates joined by a serrate suture running lengthwise round the body and corresponding with a similar suture on the distal limb, which also consists of only two plates and is slightly arched. (Pl. XXXI. figs. 4 *a*, *b*).

This beautiful *Phalacroma* is by no means common, but occurred often enough to enable us to trace its distribution from the Azores to Panama.

P. HINDMARCHII, sp. n. Body divided into two unequal limbs by the girdle, nearly globular, with a protrusion at proximal end, uniformly marked with minute spherical pits; proximal limb the larger, with sail supported by three spines, the lowest having a round knob at the end; distal limb highly arched. (Pl. XXXI. fig. 5.)

Its distribution is from lat. 34° N. to lat. 14° N. It is closely allied to *P. operculatum*, differing from it principally in the singular protrusion from the proximal limb and in the character of the sail.

P. DOLICHOPTERYGIUM, sp. n. Body very unequally divided by the girdle, and uniformly covered with minute spherical pits; girdle with its margins projecting as a fine membrane supported by a row of spines; proximal limb with sail decurrent its whole length, narrower and projecting laterally on the side bearing the sail; distal limb very slightly arched. (Pl. XXXI. fig. 8 *a*, *b*.)

This species occurs from lat. 8° 51′ N. to lat. 35° N. It resembles most nearly *P. Mitra*, from which it may be distinguished by its shape, long decurrent sail, and finer markings.

PHALACROMA RUDGEI, sp. n. Body unequally divided by the girdle, with no markings, ovate in side view, of proportionately great breadth in ventral view, with broad flat suture-plates on both limbs; proximal limb with narrow and short sail; distal limb slightly arched. (Pl. XXXI. figs. 6 *a*, *b*.)

It appeared only once in our collections, viz. in lat. 37° 55′ N., long. 36° 42′ W., where it was found by Capt. Rudge of the 'Avon.'

DINOPHYSIS, Ehrenb.

This genus abounds especially in the Atlantic between the Azores and Barbados. *D. Homunculus*, Stein, occurred very constantly from lat. 48° N. to Panama; *D. rotundata*, Clap. & Lachm., from lat. 41° N. to the Caribbean; *D. hastata*, Stein, occurred from lat. 41° N. to lat. 18° N.; *D. uracantha*, Stein, from lat. 43° N. to Panama; *D. sphærica*, Stein, from lat. 44° N. to lat. 18° N.; *D. acuta*, Ehrenb., from lat. 49° N. to lat. 29° N.; *D. Sacculus* once only in lat. 41° 30′ N., long. 28° W. In addition to these we found one new species, viz.:—

D. RUDGEI, sp. n. Body globular; proximal limb covered with very large circular pits, and with a terminal spear-like appendage and a very small sail; girdle with proximal margin produced and forming a transparent collar, and distal margin prolonged into a short cylindrical funnel. (Pl. XXXI. fig. 9 *a*, *b*.)

It occurred only on the voyage of the 'Avon' in lat. 33° 20′ N., long. 43° 9′ W.

D. SCHUETTII, nob.

In his 'Peridiniaceæ of the German National Plankton Expedition' (tab. ii. fig. 9). Dr. Schütt has figured under the name of *Dinophysis uracantha*, Stein, a specimen which, on comparison with Stein's figure ('Infusionsthiere,' pt. iii. tab. xx. figs. 22, 23), presents manifest differences. We have found an organism (Pl. XXXI. fig. 10) agreeing with Dr. Schütt's figure. It differs from *D. uracantha* in the form of its sail and in having no terminal spine, but with a process supporting a small, narrow membrane at its base, placed on the dorsal side. We have separated it from *D. uracantha* under the above name.

AMPHISOLENIA, Stein.

A. palmata, Stein, occurs from lat. 38° N. to lat. 14° N., and *A. Thrinax*, Schütt, from lat. 29° N. to lat. 27° N.

Another species, described below, which appears to be intermediate in the characters it presents between *A. palmata*, Stein, and *A. Thrinax*, Schütt (in 'Pflanzenleben der Hochsee,' p. 33), occurred in the same place and in the collections made by the 'Elbe.'

A. BIFURCATA, sp. n. Proximal limb composing the body; the distal limb composed of two plates and reduced to a flat membrane; margins of girdle expanded into two frills equal in size and of like appearance; proximal limb elongate, swollen to

three times the ordinary diameter immediately below the foramen, bifurcate below, bifurcations slightly swollen in the middle and each with a small spur near the extremity. (Pl. XXXI. fig. 1.)

From lat. 30° N. and long. 40° W. with the other species, and in lat. 4°–6° S., long. 32° 32′ to 30° 39′ W. It reaches long. 72° W. in lat. 16° to 17° N.

Amphisolenia inflata, sp. n. Proximal limb composing much the greater part of the body, swollen for half its length to 5 times (lateral view), 2–3 times (foraminal view) immediately below foramen, unbranched, without a spur at the extremity; distal limb reduced to a flat membrane; girdle with each margin expanded into a frill, the distal one wider, the proximal decurrent to foramen. (Pl. XXXI. figs. 2 *a*, *b*.)

It occurs in lat. 34° to 39° N., long. 39° to 32° W.

Histioneis, Stein.

Owing to our discovery principally of *Histioneis Francescæ* and of such other forms near it as *H. Para*, it is clear that the distinction between Stein's two genera *Histioneis* and *Ornithocercus* disappears. At first we had serious doubts as to the inclusion of *O. splendidus*, Schütt (= *O. splendens*, Schütt, in Engler and Prantl, Nat. Pflanzenfam. Peridin. p. 29), which appeared to have in place of a sail three spines, somewhat like those of a *Ceratocorys*. However, on careful examination we found specimens with an extremely fragile sail of much the same character otherwise as that of *H. magnifica* (see Pl. XXXII. figs. 1 *a*, *b*, *c*) with similar terminal thickenings. This has escaped attention from two causes: (1) it is frequently broken, and represented only by the three main supports hanging down and giving the appearance of *Ceratocorys* spines; and (2) by this species habitually presenting under the microscope its ventral aspect, in which the sail, if present, appears very foreshortened. The distal limb is larger and more arched in *H. splendida* than in any other *Histioneis*, and the two plates composing it are joined by a zigzag suture (see Pl. XXXII. fig. 1 *c*). Its collar and funnel are alike, and in this important character it is distinct from the other species of *Histioneis*. We suggest the establishment of a section of the genus for the reception of such forms under the name *Paraschuettia*, which would be not only descriptive (though barbarously), but also commemorative of Dr. Schütt's great services to the study of phyto-plankton.

H. splendida is a comparatively rare organism in our gatherings, but we found it from lat. 34° 30′ N., long. 30° W., to lat. 13° 6′ N., long. 78° 44′ W.

H. magnifica (Pl. XXXII. fig. 2) is one of the most abundant and constantly occurring Peridiniaceæ in the warm Atlantic, ranging, according to our records, from lat. 44° N. to lat. 14° 44′ S. in the Atlantic an dto Panama in the Caribbean. It varies greatly in size and in the character of the markings on the sail and funnel. We have represented a fairly typical one in fig. 2 for the purpose of comparison with the other species.

H. remora, Stein, occurred in gatherings from lat. 31° N. to lat. 8° N. in the Atlantic, and to Panama in the Caribbean; *H. biremis*, Stein, from lat. 31° N. to Panama; and *H. crateriformis*, from lat. 31° N., long. 35° W., to lat. 16° N., long. 77° W., *i. e.* practically the same distribution as the other two. Among the new species which we

describe, lat. 35° N. represents the farthest north of *Histioneis Francescæ*; lat. 31° N. of two, viz. *H. Highleii* and *H. Mitchellana*; lat. 30° N. of *H. Helenæ*; lat. 29° N. of *H. Dolon*; lat. 33° N. of *H. Para*; lat. 24° N. of *H. dentata*; and lat. 23° N. of *H. Milneri*. It will be seen, therefore, that these additions to the genus are all, like the species already known, confined to the warm Atlantic. On Pl. XXXII. fig. 6 we have figured *H. biremis*, Stein, a different form from Stein's, though clearly the same species. In our specimens the funnel is of somewhat different shape and quite differently marked, and the sail also differently marked. The latter variation occurs in most species. Our records are rich in new species of this remarkable genus.

HISTIONEIS FRANCESCÆ, sp. n. Body irregularly globular, composed of proximal limb and girdle, slightly compressed laterally, pitted; girdle broad, pitted, distal margin expanded into a large wide funnel with unbranched radiate nervation and entire edge, proximal margin forming a broad pitted collar, open on dorsal as well as on ventral side, one half continued down on ventral side to the sail, the division between end of collar and sail near foramen; sail extending underneath the proximal limb along the junction of the two plates that form the limb, with straight, occasionally branching nervation (the nerves being fairly uniform in size), and pitted, especially near the body, with an entire margin bordered with parallel peripheral lines; distal limb reduced to a small flat membrane at base of funnel. (Pl. XXXII. fig. 3.)

It ranges from lat. 35° 20′ N. to lat. 14° to 16° N., long. 58° 32′ W. It never occurs plentifully even though it has so wide a distribution, practically from the Azores to Barbados.

It is chiefly on the characters afforded by this singularly beautiful species that the generic distinction between Stein's *Ornithocercus* and *Histioneis* breaks down. The collar open on the dorsal side, with the other characters, brought this species into line with our *H. Para*, *H. biremis*, Stein, &c.; while, on the other hand, in describing it we have to bear in mind the necessity of distinguishing it from *H. magnifica*, the original type of Stein's *Ornithocercus*. It may readily be distinguished from it by the collar open on the dorsal side and by the whole character of the sail, which has no specially stout nerves running down to thickened endings as in *H. magnifica*, but a close-set uniform nervation, with pits near the body.

H. PARA, sp. n. Proximal limb from semi-globular to semi-oval in shape, very little if at all compressed laterally, pitted, with a long, narrow, pointed, flat sail, sometimes pitted near the point only (and in that case with a few transverse thickened bars), decurrent to the extremity of limb or nearly so; girdle broad at the proximal margin, pitted, the proximal margin expanded into a collar, unmarked, but supported by a few upright thickened bars, open on both dorsal and ventral sides, but not decurrent to the sail, which, however, reaches its base; distal margin expanded into a broad funnel with radiating nervation, the nerves unbranched, edge entire; distal limb reduced to a flat membrane. (Pl. XXXII. figs. 4 *a, b, c.*)

This species was at times fairly plentiful from 28° N. in the Atlantic to Panama in

the Caribbean. It is most nearly allied to *H. Francescæ*, from which it differs in the totally different sail, the plain, unpitted, and not decurrent collar, and the shape of the body. It is constant in all its characters except the markings on the sail and the slightly varying shape of the proximal limb.

Histioneis dentata, sp. n. Proximal limb semi-ovate, laterally compressed halfway towards extremity, pitted, with an irregular flat sail; sail narrow in its upper part, but at once widening, then narrowing again irregularly, with large pits of varying size, and with one supporting thickened bar projecting from the extremity of the limb and the sail itself extending beyond it on the dorsal side; girdle pitted, expanding at proximal margin into a collar, with one large, clear, unmarked area on each half, but supported on the dorsal and ventral sides by thickened pitted ends, open at both dorsal and ventral sides and decurrent on one side in a narrow thickened and pitted band past the foramen to the sail; distal margin expanding into a funnel with a dentate edge, and with much thickened, upright, radiate bars, each thickest at the top and toothed in a radial direction; distal limb reduced, but bearing a tuft of upright spines emerging slightly above the funnel. (Pl. XXXIII. figs. 4 *a*, *b*.)

Found only in lat. 24°–25° N., long. 51°–50° W.

H. Highleii, sp. n. Proximal limb pitted all over, hollowed above at the girdle, and continued downward into a long cylindrical extension rounded at the end, giving the whole limb a trifurcate appearance; with sail narrow where it joins the limb, broadening outwards, supported at its upper and lower margins by thickened bars, unmarked except in lower outer corner; girdle pitted, with its proximal margin expanding into a large, high, unmarked collar slightly constricted near the top, open on both dorsal and ventral sides, and bearing as an appendage on the ventral side a membranous expansion like a small sail set above the true one; upper margin of girdle expanded into a funnel narrow and unmarked below, then slightly pitted where it begins to expand, and with radiate thickened bars above, the bars bearing each a minute knob at the top, edge of funnel entire; distal limb almost suppressed, consisting of a minute flat membrane at base of funnel. (Pl. XXXII. fig. 5.)

From lat. 31° N. to lat. 23° N. in the Atlantic.

H. Milneri, sp. n. Proximal limb short, stout, curved, faintly and sparsely pitted, and with a row of distinct punctate markings where it borders the girdle, and a similar row parallel to it on the girdle itself, bearing on the ventral side the sail supported by thickened curved bars top and bottom, and bordered with parallel peripheral thickened lines with two lateral flaps beneath; proximal margin of girdle expanded into a wide high collar unmarked in its lower half, but with a reticulum of fine nerves on the upper half, open on the dorsal and ventral sides and supported by thick upright bars at the openings, one side decurrent in a large wide expansion, which meets the sail and forms in fact itself an upper sail with reticulate nervation

and a border like that of the lateral sail; upper margin of girdle forming a long, narrow, tubular funnel expanding slightly above and toothed at the edge; distal limb suppressed, and represented only by a minute membrane at the base of this funnel. (Pl. XXXIII. fig. 1.)

This singular organism occurs from lat. 23° N. in the Atlantic to Panama in the Caribbean.

Histioneis Mitchellana, sp. n. Proximal limb short and elongate in a dorsi-ventral direction, deeper on the dorsal side, very faintly marked, bearing the sail on a projecting semicircular thickened bar; sail reticulate and forming two lateral flaps, confluent on its ventral margin with the decurrent edge of collar; proximal margin of girdle forming a large wide collar, unmarked in the lower half, which expands laterally, reticulate above, narrowing again laterally towards the top, where the edge is entire, one side decurrent to the sail and reticulate; distal margin forming a narrow tubular funnel expanding and reticulate above, edge entire; distal limb suppressed, and represented only by a membrane at base of funnel. (Pl. XXXIII. figs. 3 *a*, *b*.)

From lat. 31° N. to lat. 22° N.

H. Helenæ, sp. n. Proximal limb short, stout, curved, with a row of distinct punctate markings where it borders the girdle, parallel to a similar row on the girdle itself, bearing on the ventral side the sail; sail with faint reticulate markings on its outer portion, which is so curved as to form a lateral flap, bearing also two unmarked, rounded, opposite wings inserted parallel and near to the collar; proximal margin of girdle forming a collar, the upper part of which bears fine reticulate markings, and its edge fine bristles at short intervals, one side decurrent to the sail; distal margin of girdle produced into a long tubular funnel expanding above, unmarked, and with fine bristles projecting from the edge; distal limb suppressed, and represented only by a minute membrane at base of funnel. (Pl. XXXIII. figs. 2 *a*, *b*.)

From lat 30° N. to lat 16° N.

H. Dolon, sp. n. Proximal limb short, stout, curved, very finely punctate, and with a row of distinct punctate markings where it borders the girdle, parallel to a similar row on the girdle itself; bearing a large sail, which is so curved as to form a large transverse hollow like a filled balloon-topsail, marked with parallel peripheral lines, bearing also two opposite side-wings also hollowed, unmarked, inserted near to and parallel with collar; proximal margin of girdle forming a high collar reticulate above, decurrent on one side to the sail and forming in fact an upper sail, marked; distal margin prolonged into a long funnel expanding widely above, unmarked except at the edge, where it is bordered by a band with fine vertical markings; distal limb suppressed, and represented only by a plate at base of funnel. (Pl. XXXIII. figs. 5 *a*, *b*.)

Found in lat. 28° N., long. 40° W.; and again in lat. 29° N. and long. 42° to 44° W.

CITHARISTES, Stein.

Both the known species of *Citharistes* occurred: *C. regius*, Stein, once only, viz. in lat. 31° N., long. 35° 30′ W.; *C. Apsteinii*, Schütt, though never plentiful, occurred from lat. 34° to 39° N. in the Atlantic to Colon in Panama. We have figured *C. Apsteinii* on Pl. XXXI. figs. 3 *a*, *b*. Schütt states that in this species there is a single large dorsal spine bounding the cavity formed by the curve of the body. In fig. 3 *b* we have given a ventral view of *C. Apsteinii*, showing that there are two spines, marked with large pits and expanding above, where they meet the body.

TABLE I.

R.M.S. 'PARA.'—VOYAGE I. (CAPT. MILNER).

	Lat. 41° 30′ N., long. 19° 40′ W. Temp. 57°. Jan. 30.	Lat. 36° N., long. 28° 40′ W. Temp. 62°. Feb. 1.	Lat. 22° 20′ N., long. 48° W. Temp. 70°. Feb. 5.	Lat. 18° 50′ N., long. 52° 20′ W. Temp. 77°. Feb. 6.	Lat. 15° N., long. 57° W. Temp. 78°. Feb. 7.	Lat. 25° N., long. 51° W. Temp. 70°. March 9.	Lat. 30° N., long. 46° 30′ W. Temp. 70°. March 10.	Lat. 40° N., long. 31° W. Temp. 62°. March 13.	Lat. 43° N., long. 24° W. Temp. 60°. March 14.	Lat. 46° N., long. 17° W. Temp. 56°. March 15.
	1.	3.	8.	9.	10.	12.	13.	16.	17.	18.
Ceratium Tripos, *Nitzsch*	*	*	*	*	*	*	*	*	*	*
„ Furca, *Dujard.*	*	..	..	..	..	..	..	*	*	*
„ „ *var.* baltica	*	..	*	..	*	*	*	*	..	*
„ Fusus, *Dujard.*	*	..	..	..	*	..	..	*	*	
„ Candelabrum, *Stein*	..	*	..	..	..	..	*			
„ Limulus, *Gourret*	..	*	..	..	..	*	*			
Gonyaulax polygramma, *Stein*	..	..	..	..	..	*				
„ Jolliffei, *Murr. & Whitt.*	..	..	..	..	..	..	*			
„ Highleii, *Murr. & Whitt.*	..	..	..	..	..	..	*			
Goniodoma acuminatum, *Ehrenb.*	*	*	..	*	*	*	*	*	..	*
„ Milneri, *Murr. & Whitt.*	..	..	*	*	*	..	*			
Peridinium divergens, *Ehrenb.*	*	*	*	..	*	*	*	..	..	*
„ Michaelis, *Ehrenb.*	..	*	..	..	..	..	*			
„ tristylum, *Stein*	*	..	..	..	..	*				
„ Globulus, *Stein*	..	..	..	..	..	..	..	*	*	*
Podolampas bipes, *Stein*	..	*	..	*	*	*	*			
„ palmipes, *Stein*	..	*	..	*	..	*	*			
Amphidoma Nucula, *Stein*	*	*	..	..	*	..	*	*	..	*
Oxytoxum Scolopax, *Stein*	*	..	..	..	..	..	..	*		
„ Milneri, *Murr. & Whitt.*	..	..	..	..	..	..	*			
„ constrictum, *Schütt*	..	..	..	*						
„ reticulatum, *Schütt*	*									
Ceratocorys horrida, *Stein*	..	..	..	*	*	*				
Phalacroma operculatum, *Stein*	*	*	..	*	..	*	..	*		
„ doryphorum, *Stein*	..	*	*	..	..	..	*	*		
„ Mitra, *Schütt*	*									
„ Blackmani, *Murr. & Whitt.*	..	*								
Dinophysis rotundata, *Clap. & Lachm.*	..	*								
„ Homunculus, *Stein*	*	*								
„ hastata, *Stein*	..	..	..	..	..	..	*			
„ uracantha, *Stein*	..	*								
„ acuta, *Ehrenb.*	..	..	..	..	..	..	*			
„ sphærica, *Stein*	..	..	..	..	..	..	*	*		
Histioneis magnifica, *Murr. & Whitt.*	*	*	*	*	..	..	*			
„ Helenæ, *Murr. & Whitt.*	..	..	..	..	..	..	*			
„ Mitchellana, *Murr. & Whitt.*	..	..	..	..	..	..	*			
Pyrocystis Noctiluca, *J. Murr.*	..	..	..	*	*	..	..	*		
„ fusiformis, *J. Murr.*	..	..	..	..	..	..	..	..	*	
„ Lunula, *Schütt*	..	*	..	..	*					

TABLE II.

R.M.S. 'PARA.'—VOYAGE II. (CAPT. MILNER).

	Lat. 44° 50′ N., long. 13° 40′ W. Temp. 52°. April 9.	Lat. 38° N., long. 24° 10′ W. Temp. 61°. April 11.	Lat. 24° N., long. 45° W. Temp. 73°. April 15.	Lat. 21° N., long. 49° W. Temp. 76°. April 16.	Lat. 18° 20′ N., long. 52° 40′ W. Temp. 79°. April 17.
	19.	23.	24.	25.	26.
Cladopyxis brachiolata, *Stein*	..	..	*	..	*
Ceratium Tripos, *Nitzsch*	*	*	*	*	*
" Furca, *Dujard.*	*	..	*		
" " *var.* baltica	*	*	*	..	*
" Fusus, *Dujard.*	..	..	..	..	*
" Candelabrum, *Stein*	..	..	*	*	
" Limulus, *Gourret*	..	..	*	..	*
Gonyaulax polygramma, *Stein*	..	..	*		
" Jolliffei, *Murr. & Whitt.*	..	..	..	*	*
" glyptorhynchus, *Murr. & Whitt.*	..	..	..	*	*
Goniodoma acuminatum, *Ehrenb.*	..	..	*		
" Milneri, *Murr. & Whitt.*	..	..	*	..	*
Peridinium divergens, *Ehrenb.*	..	*	*	..	*
" Michaelis, *Ehrenb.*	..	..	..	..	*
" Globulus, *Stein*	..	..	..	..	*
" Blackmani, *Murr. & Whitt.*	..	..	..	..	*
Diplopsalis sæcularis, *Murr. & Whitt.*	..	..	..	..	*
Podolampas bipes, *Stein*	..	..	*	..	*
Amphidoma Nucula, *Stein*	*	..	..	..	*
Oxytoxum Scolopax, *Stein*	..	..	..	..	*
" Milneri, *Murr. & Whitt.*	..	..	..	..	*
" reticulatum, *Schütt*	..	..	..	..	*
Ceratocorys horrida, *Stein*	..	..	*	..	*
Phalacroma operculatum, *Stein*	..	..	..	..	*
" doryphorum, *Stein*	..	..	*	*	*
Dinophysis hastata, *Stein*	..	..	..	..	*
" uracantha, *Stein*	..	..	..	..	*
" sphærica, *Stein*	..	..	..	..	*
Histioneis magnifica, *Murr. & Whitt.*	..	*	..	*	
Pyrocystis Noctiluca, *J. Murr.*	..	..	*	*	
" fusiformis, *J. Murr.*	..	..	*	*	

TABLE III.—R.M.S. 'Para,' Voyage III. (Capt. Milner).

	Lat. 44° 38′ N., long. 12° 38′ W. Surf. Temp. 64°. June 18.						Lat. 43° 12′ N., long. 15° 37′ W. Surf. Temp. 66°. June 19.	Lat. 40° 44′ N., long. 19° 47′ W. Surf. Temp. 67°. June 20.		Lat. 38° 25′ N., long. 24° 10′ W. Surf. Temp. 69°·5. June 21.	Lat. 35° 47′ N., long. 28° 37′ W. Surf. Temp. 71°. June 22.			Lat. 32° 47′ N., long. 33° 2′ W. Surf. Temp. 73°. June 23.			Lat. 29° 49′ N., long. 37° 20′ W. Surf. Temp. 75°. June 24.		Lat. 26° 44′ N., long. 41° 26′ W. Surf. Temp. 75°. June 25.			Lat. 23° 44′ N., long. 45° 30′ W. Surf. Temp. 78°·5. June 26.	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Cladopyxis brachiolata, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..
Ceratium Tripos, *Nitzsch*	..	*	*	*	*	*	..	*	*	*	*	*	*	*	*	*	*	*	*	*	..	*	*
,, Furca, *Dujard.*	*	..	*	..	*	*	*	*	..	..	*	..	..	*	..	..	..	..	..	..	..	..	..
,, ,, *var.* baltica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, Fusus, *Dujard.*	..	..	*	*	*	*	*	*	..	*	*	*	..	*	*	..	*	*	..	..	..	..	..
,, Candelabrum, *Stein*	..	..	..	..	..	..	..	*	..	*	..	*	*	*	..	*	..	*	*	*	..	*	..
,, Limulus, *Gourret*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	*
,, gravidum, *Gourret*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, digitatum, *Schütt*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gonyaulax birostris, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, Jolliffei, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Goniodoma acuminatum, *Stein*	*	*	*	*	*	*	*	*	*	*	*	*	*	..	*	*	*	*	*	*	*	*	*
,, Milneri, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, fimbriatum, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Diplopsalis Lenticula, *Bergh*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, sæcularis, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..
Peridinium divergens, *Ehrenb.*	..	*	*	..	*	*	*	*	*	*	*	*	..	*	..	*	*	*	*	*	*	*	*
,, Michaelis, *Ehrenb.*	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*
,, tristylum, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, Globulus, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	*	..	..	..	*	..
,, Blackmani, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, Hindmarchii, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, trirostre, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Podolampas bipes, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	*
,, palmipes, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Amphidoma Nucula, *Stein*	..	*	*	*	*	*	*	*	..	*	*	*	..	*	*	*	*	*	*	*	*	*	*
Oxytoxum Scolopax, *Stein*	..	..	..	..	..	..	..	*	..	*	*	*	..	..	..	*	..	..	..	..	..	..	..
,, diploconus, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..
,, Milneri, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..
,, constrictum, *Schütt*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..
,, reticulatum, *Schütt*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ceratocorys horrida, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, spinifera, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Phalacroma operculatum, *Stein*	..	..	..	..	..	..	*	..	..	*	*	*	..	*	*	*	..	..	*	..	*	*	..
,, Globulus, *Schütt*	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..
,, doryphorum, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	*	*	*
,, Mitra, *Schütt*	..	..	..	..	..	..	..	*	..	..	..	..	*	*	..	..	..	..	..	..	..	..	..
,, Blackmani, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*
,, Jourdani, *Schütt*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, Hindmarchii, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, porodictyum, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dinophysis rotundata, *Clap. & Lachm.*	..	..	..	..	..	..	..	*	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..
,, Homunculus, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	*	*	*	..	*	..	..	*	..	..	..
,, hastata, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..
,, uracantha, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*
Histioneis magnifica, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	*	*	*	*	*	*	*	..	*	*	*	*	*	*	..
,, splendida, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, remora, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, Francescæ, *G. Murr.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, biremis, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, Para, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, Milneri, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Citharistes Apsteinii, *Schütt*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pyrocystis Noctiluca, *J. Murr.*	..	..	..	..	..	..	..	..	*	..	*	*	*	..	*	..	..	*	*	*	..	*	*
,, fusiformis, *J. Murr.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, Lunula, *Schütt*	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..
,, bicornis, *Blackm.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Halosphæra viridis, *A. Schmidt*	..	..	..	..	..	..	..	*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..

	Lat. 20° 55′ N., long. 49° 40′ W. Surf. Temp. 78°. June 27.		Lat. 17° 58′ N., long. 53° 32′ W. Surf. Temp. 78°. June 28.		Lat. 14° 55′ N., long. 57° 26′ W. Surf. Temp. 81°. June 29.			Off Barbados.		Lat. 14° 13′ N., long. 63° 5′ W. Surf. Temp. 82°. July 1.	Lat. 16° 6′ N., long. 68° 10′ W. Surf. Temp. 84°. July 2.			Lat. 14° 23′ N., long. 77° 57′ W. Surf. Temp. 82°. July 6.		Arrive Colon. Surf. Temp. 81°.		Colon Bay. Surf. Temp. 85°. July 10.	Colon Bay. Surf. Temp. 86°. July 11.	Left Colon. Surf. Temp. 83°. July 16.			Lat. 13° 6′ N., long. 78° 44′ W. Surf. Temp. 82°. July 17.	
	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Cladopyxis brachiolata, *Stein*	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ceratium Tripos, *Nitzsch*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	..	*	*	*	*	*	*	*
,, Furca, *Dujard.*	..	..	*	*	*	..	..	*	..	..	..	*	..	*	..	*	*	*	*	*	..	*	..	*
,, ,, *var.* baltica	..	..	*	..	..	*	*	..	..	*	*	*	..	..	..	..	..	..	..	..	*	*	*	*
,, Fusus, *Dujard.*	..	..	*	*	*	*	*	*	..	*	*	*	..	*	..	*	..	*	..	..	*	..	*	..
,, Candelabrum, *Stein*	*	..	*	*	*	*	*	*	*	*	*	*	..	*	*	*	..	*	..	..	..	*	*	*
,, Limulus, *Gourret*	*	..	*	..	..	*	..	*	*	*	*	..	*	*	*	*	..	..	..	..	..	*	*	*
,, gravidum, *Gourret*	..	..	..	..	..	..	..	..	..	..	*	*	*	*	..	..	..	..	..	..	..	..	..	*
,, digitatum, *Schütt*	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..
Gonyaulax birostris, *Stein*	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, Jolliffei, *Murr. & Whitt.*	..	..	*	..	..	..	..	..	..	..	*	..	*	*	..	*	..	*	..	..	..	*	..	*
Goniodoma acuminatum, *Stein*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	..	*	*	*	..	*	*	*
,, Milneri, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, fimbriatum, *Murr. & Whitt.*	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Diplopsalis Lenticula, *Bergh*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, sæcularis, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*
Peridinium divergens, *Ehrenb.*	*	*	*	..	*	..	*	..	*	*	*	*	*	*	*	*	..	*	*	*	..	*	*	*
,, Michaelis, *Ehrenb.*	*	..	..	..	..	..	..	..	..	..	*	..	..	*	..	..	..	..	..	..	..	..	..	..
,, tristylum, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	*	*	*	*	*	..	..	..	..	..	..	*
,, Globulus, *Stein*	..	..	*	..	..	..	..	..	..	*	..	*	..	..	*	..	..	..	..	..	..	..	..	..
,, Blackmani, *Murr. & Whitt.*	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*
,, Hindmarchii, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, trirostre, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Podolampas bipes, *Stein*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	..	*	..	..	*	..	..	*
,, palmipes, *Stein*	..	..	*	*	..	..	..	..	..	*	..	*	*	..	..	*	..	*	..	..	..	..	..	*
Amphidoma Nucula, *Stein*	*	*	*	*	..	..	..	*	..	*	*	*	..	*	*	*	..	..	*	*	..	..	..	*
Oxytoxum Scolopax, *Stein*	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, diploconus, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, Milneri, *Murr. & Whitt.*	*	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*
,, constrictum, *Schütt*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, reticulatum, *Schütt*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ceratocorys horrida, *Stein*	..	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	..	*	*	*	*
,, spinifera, *Murr. & Whitt.*	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Phalacroma operculatum, *Stein*	*	*	*	*	*	*	..	..	..	..	*	*	*	*	*	*	..	..	..	..	..	*	..	*
,, Globulus, *Schütt*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, doryphorum, *Stein*	*	*	*	*	*	..	*	..	..	..	*	*	..	*	..	*	..	*	..	..	..	..	..	*
,, Mitra, *Schütt*	*	*	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	*	..	*	..	*	..	*
,, Blackmani, *Murr. & Whitt.*	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, Jourdani, *Schütt*	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, Hindmarchii, *Murr. & Whitt.*	..	..	*	..	..	..	..	..	*	*	..	..	..	..	..	..	..	..	..	..	..	..	*	..
,, porodictyum, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dinophysis rotundata, *Clap. & Lachm.*	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*
,, Homunculus, *Stein*	..	*	..	..	..	..	..	..	..	..	..	..	..	*	..	*	*	*	*	*	..	*	..	..
,, hastata, *Stein*	*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, uracantha, *Stein*	..	*	..	..	..	..	..	..	..	..	*	..	*	..	..	..	..	..	..	..	..	..	..	*
Histioneis magnifica, *Murr. & Whitt.*	*	*	*	*	*	*	*	..	..	*	*	*	*	*	*	*	..	*	*	*	*	*	*	*
,, splendida, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..
,, remora, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*
,, Francescæ, *G. Murr.*	..	*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, biremis, *Stein*	..	..	..	..	..	..	..	..	..	..	*	*	*	..	..	..	..	..	..	..	..	..	*	*
,, Para, *Murr. & Whitt.*	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*
,, Milneri, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	*	*	..	..	..	..	..	..	..	..	..	..	..	..
Citharistes Apsteinii, *Schütt*	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	*	..	..	..	..	..	..	..	..
Pyrocystis Noctiluca, *J. Murr.*	*	*	*	*	..	*	*	..	..	*	*	*	*	*	*	..	..	..	..	..	..	*	*	*
,, fusiformis, *J. Murr.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, Lunula, *Schütt*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	*	..	..
,, bicornis, *Blackm.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Halosphæra viridis, *A. Schmidt*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

	Off Point Morant, Jamaica. Surf. Temp. 83°. July 20.	Lat. 15° 12′ N., long. 58° 7′ W. Surf. Temp. 81°·5. July 25.			Lat. 18° 36′ N., long. 55° 42′ W. Surf. Temp. 81°·5. July 26.			Lat. 22° 2′ N., long. 52° 46′ W. Surf. Temp. 80°. July 27.			Lat. 25° 41′ N., long. 49° 31′ W. Surf. Temp. 81°. July 28.			Lat. 29° 11′ N., long. 45° 52′ W. Surf. Temp. 81°. July 29.			Lat. 32° 8′ N., long. 41° 25′ W. Surf. Temp. 80°·5. July 30.	Lat. 37° 44′ N., long. 30° 55′ W. Surf. Temp. 74°. Aug. 1.		Lat. 43° 4′ N., long. 20° 0′ W. Surf. Temp. 67°. Aug. 3.		Lat. 45° 38′ N., long. 13° 53′ W. Surf. Temp. 65°. Aug. 4.	
	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
Cladopyxis brachiolata, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ceratium Tripos, *Nitzsch*	*	*	..	*	..	*	*	*	*	*	*	*	*	*	*	*	*	..	*	*	*	*	*
,, Furca, *Dujard.*	..	..	..	*	..	..	*	..	..	*	..	*	..	*	*	*	..	..	..	*	..	*	*
,, ,, *var.* baltica	*	*	..	..	*	..	*	*	*	*	..	*	*	..	*	..	*	..	..	..	..	..	..
,, Fusus, *Dujard.*	..	..	..	..	*	*	*	*	*	..	*	*	*	*	*	*	*	..	*	*	..	*	*
,, Candelabrum, *Stein*	*	..	..	*	*	..	..	*	*	*	*	*	*	..	*	..	..	..	..	*	..	..	..
,, Limulus, *Gourret*	..	..	..	..	..	..	..	*	*	..	*	*	*	*	..	..	..	..	*	..	..	..	..
,, gravidum, *Gourret*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, digitatum, *Schütt*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gonyaulax birostris, *Stein*	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	*	..	..
,, Jolliffei, *Murr. & Whitt.*	..	..	..	..	..	..	..	*	*	*	*	..	..	*	..	..	..	..	..	..	..	..	..
Goniodoma acuminatum, *Stein*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
,, Milneri, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	*	*	..	*	..	..	..	..
,, fimbriatum, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Diplopsalis Lenticula, *Bergh*	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..
,, sæcularis, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Peridinium divergens, *Ehrenb.*	..	..	*	..	*	..	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
,, Michaelis, *Ehrenb.*	..	..	..	..	..	..	..	*	..	..	..	..	..	*	..	*	..	..	..	..	..	*	*
,, tristylum, *Stein*	*	..	*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..
,, Globulus, *Stein*	..	..	..	..	..	..	..	..	..	*	..	*	*	..	..	..	..	..	..	..	..	..	..
,, Blackmani, *Murr. & Whitt.*	..	..	..	..	..	..	..	*	*	..	*	..	..	..	..	..	..	..	..	..	..	..	..
,, Hindmarchii, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..
,, trirostre, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..
Podolampas bipes, *Stein*	*	*	*	..	*	*	*	*	*	*	*	*	*	*	*	*	*	*	..	..	..	*	..
,, palmipes, *Stein*	*	..	*	..	..	..	*	*	..	..	*	*	*	*	*	..	*	..	..	..	..	..	..
Amphidoma Nucula, *Stein*	*	*	*	..	*	*	..	*	*	*	*	*	..	*	*	*	*	..	*	..	*	*	*
Oxytoxum Scolopax, *Stein*	..	..	..	..	..	..	..	..	*	..	..	..	..	..	*	..	..	..	..	..	..	..	..
,, diploconus, *Stein*	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	*	..
,, Milneri, *Murr. & Whitt.*	..	..	..	..	..	..	..	*	*	..	..	*	*	*	*	..	..	..	..	..	..	..	..
,, constrictum, *Schütt*	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..
,, reticulatum, *Schütt*	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..
Ceratocorys horrida, *Stein*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	..	..	..	..	..	..
,, spinifera, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Phalacroma operculatum, *Stein*	*	..	..	..	*	..	..	*	*	*	*	*	*	*	*	..	*	*	*	*	*	*	*
,, Globulus, *Schütt*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, doryphorum, *Stein*	*	..	..	..	..	..	..	*	*	*	..	*	*	..	..	..	*	*	*	..	*	..	..
,, Mitra, *Schütt*	*	..	..	..	..	..	..	..	..	*	*	*	..	..	..	..	..	*	..	..	*	..	..
,, Blackmani, *Murr. & Whitt.*	..	..	..	..	..	*	..	*	..	*	*	..	..	..	..	..	..	..	*	*	..	..	..
,, Jourdani, *Schütt*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, Hindmarchii, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	*	*	..	..	..	..	..	..	..	..	..	..	..
,, porodictyum, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..
Dinophysis rotundata, *Clap. & Lachm.*	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	*	..	..	..	..	..
,, Homunculus, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	*	..	*	*	*
,, hastata, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..
,, uracantha, *Stein*	..	..	..	..	..	..	..	*	*	..	*	..	*	..	*	..	..	*	..	..	..	..	..
Histioneis magnifica, *Murr. & Whitt.*	*	*	*	*	*	..	..	*	*	*	*	*	*	*	*	*	*	*	*	*	*	..	..
,, splendida, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, remora, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, Francescæ, *G. Murr.*	..	..	..	..	..	..	..	*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, biremis, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
,, Para, *Murr. & Whitt.*	..	..	..	..	*	..	..	*	*	*	..	*	..	..	..	..	..	..	..	..	..	..	..
,, Milneri, *Murr. & Whitt.*	..	..	..	..	..	..	..	*	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..
Citharistes Apsteinii, *Schütt*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pyrocystis Noctiluca, *J. Murr.*	*	*	*	*	..	*	..	..	*	..	*	*	*	*	*	*	..	*	..	..	..	..	..
,, fusiformis, *J. Murr.*	..	..	..	..	..	..	..	..	*	..	..	*	..	..	..	*	..	..	..	..	..	..	..
,, Lunula, *Schütt*	..	..	..	..	..	..	..	*	*	..	*	*	..	..	..	..	..	..	..	..	..	..	..
,, bicornis, *Blackm.*	..	..	..	..	..	..	..	..	*	*	*	*	*	..	..	..	..	..	..	..	..	..	..
Halosphæra viridis, *A. Schmidt*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..

TABLE IV.

R.M.S. 'Avon' (Capt. Rudge).

	Lat. 18° 18' N., long. 57° 35' W. Surf. temp. 82°. August 5.	Lat. 21° 6' N., long. 55° 17' W. Surf. temp. 79°. August 6.	Lat. 24° 9' N., long. 52° 50' W. Surf. temp. 79°. August 7.	Lat. 27° 51' N., long. 49° 15' W. Surf. temp. 80°. August 8.	Lat. 30° 37' N., long. 46° 16' W. Surf. temp. 79°. August 9.	Lat. 33° 20' N., long. 43° 9' W. Surf. temp. 79°. August 10.	Lat. 35° 36' N., long. 39° 51' W. Surf. temp. 76°. August 11.	Lat. 37° 55' N., long. 36° 42' W. Surf. temp. 74°. August 12.	Lat. 40° 29' N., long. 32° 45' W. Surf. temp. 71°. August 13.	Lat. 42° 43' N., long. 28° 24' W. Surf. temp. 68°. August 14.	Lat. 44° 27' N., long. 24° 4' W. Surf. temp. 64°. August 15.	Lat. 46° 23' N., long. 19° 17' W. Surf. temp. 63°. August 16.	Lat. 48° 3' N., long. 14° 18' W. Surf. temp. 63°. August 17.	Lat. 49° 24' N., long. 8° 46' W. Surf. temp. 62°. August 18.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
Glenodinum trochoideum, *Stein*	..	..	..	..	..	*								
Ptychodiscus Noctiluca, *Stein*	..	..	*	*	..	..	*	*	..	..	..	..	..	*
Cladopyxis brachiolata, *Stein*	..	..	*	..	..	*	*	*	*					
Ceratium Tripos, *Nitzsch*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
" Furca, *Dujard.*	..	..	*	..	..	..	..	..	..	..	*	*	*	*
" " *var.* baltica	*	*	*	..	..	*	*	*	*	*	..	*		
" Fusus, *Dujard.*	..	..	..	..	..	*	..	*	..	..	*	..	*	*
" Candelabrum, *Stein*	*	*	*	..	..	*	..	*	..	*	*			
" Limulus, *Gourret*	*	..	*	*	*	..	*	*						
Gonyaulax birostris, *Stein*	..	..	..	..	*									
" Jolliffei, *Murr. & Whitt.*	..	..	*	..	*	..	..	*						
" polygramma, *Stein*	..	..	..	..	..	..	*							
Goniodoma acuminatum, *Ehrenb.*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
" Milneri, *Murr. & Whitt.*	..	*	*	*	*	*	*							
" sphæricum, *Murr. & Whitt.*	..	..	..	..	..	*								
Diplopsalis sæcularis, *Murr. & Whitt.*	..	..	..	..	..	..	..	*						
Peridinium divergens, *Ehrenb.*	*	*	*	*	*	*	*	*	*	..	*	*	*	*[1]
" Michaelis, *Ehrenb.*	..	..	*	..	..	*	..	*	*	..	..	..	*	
" tristylum, *Stein*	*	..	..	*										
" Globulus, *Stein*	*	..	*	..	*	..	*	*	..	..	*			
" sphæricum, *Murr. & Whitt.*	..	..	..	..	..	*	..	*	*					
Podolampas bipes, *Stein*	*	..	*	..	*	*	*	..	..	..	*			
" palmipes, *Stein*	..	..	..	..	*	..	*	*						
Amphidoma Nucula, *Stein*	..	*	*	*	*	*	*	*	*	*	*	*	*	*
Oxytoxum Scolopax, *Stein*	..	..	..	..	..	..	..	*	..	*	..	*		
" constrictum, *Schütt*	..	..	..	..	..	*								
Ceratocorys horrida, *Stein*	*	*	*	*	*	*	*							
Phalacroma operculatum, *Stein*	*	*	*	*	*	*	*	*	*	*	*			
" doryphorum, *Stein*	*	..	*	*	..	..	..	*	*					
" Mitra, *Schütt*	..	*	*											
" Hindmarchii, *Murr. & Whitt.*	..	..	*											
" Cuneus, *Schütt*	..	..	*											
" Rudgei, *Murr. & Whitt.*	..	..	..	..	..	..	..	*						
Dinophysis Homunculus, *Stein*	..	..	..	..	..	..	..	*	*	*	*	*	*	
" uracantha, *Stein*	..	..	*	..	..	*								
" acuta, *Ehrenb.*	..	..	..	..	..	..	..	..	..	..	..	..	..	*
" sphærica, *Stein*	..	..	..	..	..	..	..	..	*					
" Rudgei, *Murr. & Whitt.*	..	..	..	..	..	*								
Histioneis magnifica, *Murr. & Whitt.*	*	*	*	*	*	*	*	*	*	*	*			
" Para, *Murr. & Whitt.*	*													
Pyrocystis Noctiluca, *J. Murr.*	*	..	*											
" Lunula, *Schütt*	..	..	*											
Halosphæra viridis, *A. Schmidt*	..	..	..	..	*	..	..	..	..	..	*	..	..	*[2]

[1] One specimen only.

[2] Very abundant.

TABLE VII.

R.M.S. 'Elbe' (Capt. Tindall).

	Lat. 8° 33′ N., long. 27° 59′ W. Temp. 82°. Dec. 1, 1897.	Lat. 6° 55′–4° 55′ N., long. 28° 35′–29° 19′ W. Temp. 82°. Dec. 2.	Lat. 4° 55′–4° 1′ N., long. 29° 19′–29° 13′ W. Temp. 82°. Dec. 2.	Lat. 4° 1′–2° 37′ N., long. 29° 13′–29° 45′ W. Temp. 82°. Dec. 2.	Lat. 2° 37′–0° 41′ N., long. 29° 24′–30° 35′ W. Temp. 82–80°. Dec. 3.	Lat. 0° 41′ N. to 0° 16′ S., long. 30° 38′–31° 1′ W. Temp. 80°. Dec. 3.	Lat. 0° 16′–1° 45′ S., long. 31° 1′–31° 37′ W. Temp. 80°. Dec. 3.	Lat. 1° 45′–3° 36′ S., long. 31° 37′–32° 22′ W. Temp. 80°–81°. Dec. 4.	Lat. 4°–6° 3′ S., long. 32° 32′–33° 39′ W. Temp. 81°. Dec. 4.	Lat. 13° 17′–14° 44′ S., long. 36° 46′–37° 15′ W. Temp. 81°. Dec. 7.	Lat. 8° 51′–9° 47′ N., long. 25° 36′–25° 6′ W. Temp. 77°. Jan. 14, 1898.	Lat. 9° 47′–10° 44′ N., long. 25° 6′–24° 37′ W. Temp. 77°. Jan. 14, 1898.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Ptychodiscus Noctiluca, *Stein*	..	..	..	*	..	*	..	..	..	*		
Ceratium Tripos, *Nitzsch*	*	*	*	*	*	*	*	*	*		*	*
„ Furca, *Dujard.*	..	..	..	*	..	*	*	*				
„ „ *var.* baltica	..	*	*	*	*	*	*	..	*			
„ Fusus, *Dujard.*	*	..	*	*	*	..	..	..	..	..	*	*
„ Candelabrum, *Stein*	..	..	..	..	..	*	*					
„ Limulus, *Gourret*	*	..	..	*	..	*	*		..	..	*	
Gonyaulax polygramma, *Stein*	..	..	..	*	..	..	..	..	..	..	*	
Goniodoma acuminatum, *Ehrenb.*	*	..	..	*	*	..	*	..	..	*	*	*
„ Milneri, *Murr. & Whitt.*	..	..	*									
„ fimbriatum, *Murr. & Whitt.*	..	..	..	*	..	*	..	..	..	..	*	*
Peridinium divergens, *Stein*	*	*	*	*	..	*	..	..	..	*	*	*
„ Globulus, *Stein*	*	..	..	..	..	..	*	*	*			
„ sphæricum, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	*
Podolampas bipes, *Stein*	*	..	..	..	*	..	..	..	..	..	*	*
„ palmipes, *Stein*	..	..	..	..	..	..	..	..	..	..	*	
Amphidoma Nucula, *Stein*	*	..	..	*	*	*	*	..	*			
Oxytoxum Scolopax, *Stein*	..	..	..	..	..	..	..	..				
„ constrictum, *Schütt*	..	..	..	..	*							
Ceratocorys horrida, *Stein*	*	..	*	*	*	..	..	..	..	..	*	*
„ spinifera, *Murr. & Whitt.*	..	..	..	..	*	..	*	..	*			
Phalacroma operculatum, *Stein*	..	..	..	*	..	*	..	..	*	*	*	
„ doryphorum, *Stein*	*	..	..	*	*	*	..	..	..	..	*	
„ Blackmani, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	*	
„ dolichopterygium, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	*	
Histicneis magnifica, *Murr. & Whitt.*	..	*	*	*	*	*	*	*	*		*	
„ remora, *Stein*	*											
Amphisolenia bifurcata, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	*			
Pyrocystis Noctiluca, *J. Murr.*	..	..	..	*	..	..	*	*	..	*	*	*
„ fusiformis, *J. Murr.*	..	..	..	..	..	..	..	..	..	..	*	
„ Lunula, *Schütt*	..	..	..	*	*	*	*	*	*	..	*	
„ bicornis, *Blackm.*	..	..	..	..	..	..	..	..	..	..	*	
Halosphæra viridis, *A. Schmidt*	..	..	..	..	..	..	..	..	..	..	*	

TABLE V.—R.M.S. 'Medway' (Capt. Milner).

	Lat. 42° 35′ N., long. 17° 46′ W. Temp. 62°. Aug. 28.	Lat. 39° 38′ N., long. 23° 27′ W. Temp. 68°. Aug. 29.	Lat. 36° 48′ N., long. 29° 26′ W. Temp. 72°. Aug. 30.	Lat. 33° 15′ N., long. 34° 34′ W. Temp. 77°. Aug. 31.	Lat. 30° N., long. 39° W. Temp. 77°. Sept. 1.	Lat. 26° N., long. 44° W. Temp. 80°. Sept. 2.	Lat. 23° N., long. 49° W. Temp. 80°. Sept. 3.	Lat. 19° 25′ N., long. 52° 25′ W. Temp. 80°. Sept. 4.	Lat. 10° N., long. 77° W. Temp. 83°. Sept. 23.	Lat. 9° 35′ N., long. 79° 45′ W. Temp. 83°. Sept. 23.	Lat. 10°–12° N., long. 79° W. Temp. 82°. Sept. 24 to 25.	Lat. 13° N., long. 78° W. Temp. 82°. Sept. 25.	Lat. 17° 50′ N., long. 74°–76° W. Temp. 82°. Sept. 28 to 29.	Lat. 15° 30′ N., long. 66° 30′ W. Temp. 82°. Sept. 30.	Lat. 14° 30′ N., long. 63° 30′ W. Temp. 82°. Oct. 1.	Lat. 14° N., long. 61° W. Temp. 82°. Oct. 1.	Lat. 15° N., long. 57° 40′ W. Temp. 82°. Oct. 3.	Lat. 19° 30′ N., long. 54° 30′ W. Temp. 80°. Oct. 4.	Lat. 23° 30′ N., long. 50° 30′ W. Temp. not given. Oct. 5.	Lat. 28° N., long. 45° 30′ W. Temp. 78°. Oct. 6.	Lat. 31° 20′ N., long. 41° 50′ W. Temp. 78°. Oct. 7.	Lat. 35° 20′ N., long. 37° 20′ W. Temp. 77°. Oct. 8.	Lat. 38° 40′ N., long. 33° W. Temp. 72°. Oct. 9.	Lat. 41° 30′ N., long. 28° W. Temp. 70° 67°. Oct. 10.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Ptychodiscus Noctiluca, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	*		
Cladopyxis brachiolata, *Stein*	..	*	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	*	..	*		
Ceratium Tripos, *Nitzsch*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
,, Furca, *Dujard.*	*	..	..	..	..	..	..	..	*	..	*	..	..	..	..	..	..	..	*	*	*			
,, ,, *var.* baltica	..	*	*	*	*	..	*	..	*	..	..	*	*	*	*	..	*	..	*	*	*	*	*	*
,, Fusus, *Dujard.*	*	..	*	..	..	..	..	..	..	..	*	*	*	..	..	..	..	*	*	*	*	*		
,, Candelabrum, *Stein*	..	..	..	..	..	..	*	..	..	..	*	..	..	*	*	..	..	*	*	*	*	*		
,, Limulus, *Gourret*	..	..	..	*	*	..	*	..	..	..	..	..	..	*	*	..	..	*	..	*	*	*	*	
,, gravidum, *Gourret*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	*	
,, biconicum, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*		
Gonyaulax birostris, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	*										
,, Jolliffei, *Murr. & Whitt.*	..	*	..	..	..	..	*																	
,, polygramma, *Stein*	*	*	..	*	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	*	..	..	..	*
Goniodoma acuminatum, *Stein*	..	*	..	*	*	..	*	..	..	..	..	..	..	*	..	..	..	*	*	*	*	*		
,, Milneri, *Murr. & Whitt.*	..	..	..	*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	
,, sphæricum, *Murr. & Whitt.*	..	..	..	*																				
Peridinium divergens, *Ehrenb.*	*	*	..	*	*	..	..	..	..	..	..	..	..	*	*	..	..	..	..	*	*	*	..	*
,, Michaelis, *Ehrenb.*	*	..	..	..	*	..	..	..	..	..	..	..	..	*	..	..	..	..	..	*	..	*	..	*
,, tristylum, *Stein*	..	..	..	..	..	..	*	..	..	..	..	..	..	*										
,, Globulus, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*				
,, Hindmarchii, *Murr. & Whitt.*	..	..	..	..	..	..	*																	
Podolampas bipes, *Stein*	..	..	..	*	*	..	..	..	..	..	..	..	..	*	..	..	..	*	..	*	*	*	*	
,, palmipes, *Stein*	..	..	..	*	*	..	..	..	..	..	..	..	..	*	*	..	..	..	..	*	*	*	*	
Amphidoma Nucula, *Stein*	*	*	*	*	..	..	*	..	..	*	..	*	..	*	*	..	..	*	*	*	*	*	*	
Oxytoxum Scolopax, *Stein*	*	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	*	*	*	
,, diploconus, *Stein*	*																							
,, Milneri, *Murr. & Whitt.*	..	..	..	..	*	..	..	..	..	..	..	..	..	*	..	..	..	..	..	*	*	*		
,, constrictum, *Schütt*	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	*		
,, reticulatum, *Schütt*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	*
,, tessellatum, *Schütt*	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	*			
Ceratocorys horrida, *Stein*	..	..	..	*	*	..	*	..	*	*	..	*	*	*	*	..	..	*	*	*				
Phalacroma operculatum, *Stein*	..	*	*	*	*	..	*	..	..	..	..	..	..	*	*	..	..	..	..	*	*	*	*	*
,, doryphorum, *Stein*	..	*	*	..	*	*	*	..	..	..	..	..	..	*	..	..	..	..	..	*	*	*	*	*
,, Mitra, *Schütt*	*	*	..	..	*	..	*	..	..	..	*	..	..	*	..	..	..	..	..	..	*	*	..	*
,, Blackmani, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	*			
,, Hindmarchii, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*				
Dinophysis rotundata, *Clap. & Lachm.*	..	*	..	*	*																			
,, Homunculus, *Stein*	..	*	*	..	*	..	*	..	..	*	..	..	..	..	..	..	..	..	..	..	..	*	*	*
,, uracantha, *Stein*	..	..	..	*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	*		
,, sphærica, *Stein*	..	..	*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*				
,, Sacculus, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*
Histioneis magnifica, *Murr. & Whitt.*	..	*	*	*	*	..	*	*	*	*	..	*	*	*	*	..	*	*	*	*	*	*	*	*
,, Para, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	*				
,, Francescæ, *G. Murr.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*		
Pyrocystis Noctiluca, *J. Murr.*	..	..	..	..	*	..	*	..	..	..	..	*	..	*	..	*	..	*	..	..	*	*	*	
,, fusiformis, *J. Murr.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	*
,, Lunula, *Schütt*	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	*	*	*	*
,, bicornis, *Blackm.*	..	..	*	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*			
Halosphæra viridis, *A. Schmidt*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	*

TABLE VI.—R.M.S. 'ATRATO,' VOYAGE I. (CAPT. MILNER).

	Lat. 41° N., long. 20° W. Temp. 61°. Nov. 20.	Lat. 37° 30′ N., long. 25° 20′ W. Temp. 64°. Nov. 21.	Lat. 31° N., long. 35° 30′ W. Temp. 70°. Nov. 22.	Lat. 34° 30′ N., long. 30° W. Temp. 67°. Nov. 23.	Lat. 28° N., long. 40° W. Temp. 74°. Nov. 24.	Lat. 24° 30′ N., long. 44° 47′ W. Temp. 76°. Nov. 25.	Lat. 14° N., long. 63° 30′ W. Temp. 81°. Nov. 30.	Lat. 16° N., long. 68° W. Temp. 81°. Dec. 1.	Lat. 18° N., long. 75° W. Temp. 82°. Dec. 2.	Lat. 16° 30′ N., long. 77° W. Temp. 81°. Dec. 4.	Lat. 14°–11° 30′ N., long. 78°–79° W. Temp. 80°. Dec. 5.	Lat. 10° 45′ N., long. 78° 45′ W. Temp. 80°. Dec. 6.	Lat. 9° 30′–10° N., long. 80°–83° W. Temp. 81°. Dec. 9.	Lat. 10° N., long. 83°–81° W. Temp. 81°. Dec. 10.	Lat. 10° 30′ N., long. 80°–78° W. Temp. 81°. Dec. 11.	Lat. 10° N., long. 78° W. Temp. 81°. Dec. 15.	Lat. 10°–11° 30′ N., long. 79°–80° W. Temp. 81°. Dec. 18.	Lat. 14°–15° 30′ N., long. 78° W. Temp. 81°. Dec. 19.	Lat. 17°–16° N., long. 72°–68° W. Temp. 80°. Dec. 23.	Lat. 23° 30′–24° 30′ N., long. 51°–50° W. Temp. 77°. Dec. 28.	Lat. 24°–25° N., long. 51°–50° W. Temp. 72°. Dec. 29.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Ptychodiscus Noctiluca, *Stein*	..	..	*	..	*	..	..	..	*	*	..	*	..	*	*	..	..	*			
Ceratium Tripos, *Nitzsch*	*	*	*	*	*	*	*	*	*	*	*	..	*	*	*	*	*	*	*	*	*
" Furca, *Dujard.*	*	*	*	*	..	..	*	..	*	*	*	..	*	*	..	*	..	*	*	*	*
" " *var.* baltica	*	*	..	*	..	*	*	*	..	*	*	..	*	*	*	*	*	*	*	..	*
" Fusus, *Dujard.*	*	*	*	..	*	*	*	*	*	*	*	..	..	*	..	*	..	*	..	*	*
" Candelabrum, *Stein*	..	..	*	*	*	*	*	..	..	*	..	..	*	*	*	..	*	..	..	*	*
" Limulus, *Gourret*	*	*	*	*	*	*	..	..	..	..	*	..	..	..	*	..	*	..	*	*	*
" gravidum, *Gourret*	..	*	*	..	*	..	..	..	..	..	..	..	..	*	*	..	*	*	..	*	*
Gonyaulax polygramma, *Stein*	*	*	*	*	*	*	..	..	..	*	..	..	..	..	*	..	..	*	..	*	*
" Jolliffei, *Murr. & Whitt.*	..	..	..	..	..	*	*	..	*	*	..	..	*	*	*	..	*	*			
" glyptorhynchus, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	*
" Highlei, *Murr. & Whitt.*	..	..	..	*	..	*	..	..	..	*	..	..	..	..	..	..	..	*	..	*	
Goniodoma acuminatum, *Stein*	*	*	*	*	*	*	*	..	*	*	..	..	*	..	*	..	..	..	..	*	
" Milneri, *Murr. & Whitt.*	..	..	..	..	*	*	*														
" fimbriatum, *Murr. & Whitt.*	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	*
Diplopsalis sæcularis, *Murr. & Whitt.*	..	*	..	..	..	..	..	..	..	*	..	..	*								
Peridinium divergens, *Ehrenb.*	*	*	*	*	*	*	*	..	*	*	..	*	*	*	*	*	*	*	*	*	*
" Michaelis, *Ehrenb.*	..	*	*	*	*	*	..	..	..	..	..	..	..	..	..	*	..	..	..	*	*
" Globulus, *Stein*	..	*	*	..	*	*	..	..	..	*	*	*	*	*	..	..	..	..	..	*	
" Hindmarchii, *Murr. & Whitt.*	..	..	..	..	*	*	..	..	..	..	..	..	..	..	..	..	*	..	*	*	*
" Blackmani, *Murr. & Whitt.*	..	..	..	..	..	*	..	..	..	*	..	..	..	..	..	..	*				
" spinulosum, *Murr. & Whitt.*	..				*																
" sphæricum, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	*	*	..	..	..	*	*	*	..	..	..	*	*
Podolampas bipes, *Stein*	..	..	*	*	*	*	*	..	*	*	..	*	..	*	*	..	*	..	*	*	*
" palmipes, *Stein*	*	*	*	..	*	*	..	*	..	*	*	*	..	*	..	*	..	*	*	..	*
Amphidoma Nucula, *Stein*	*	*	..	*	..	*	*	*	*	*	*	..	..	*	*	..	..	*	..	*	*
Oxytoxum Scolopax, *Stein*	*	*	*	..	..	*	..	..	..	*	..	..	..	*							
" diploconus, *Stein*	..	..	*	..	..	..	..	..	..	*	..	*	..	..	..	..	..	..	*	..	*
" Milneri, *Murr. & Whitt.*	*	*	*	*	*	*	..	..	..	..	..	..	..	*	..	..	..	..	..	*	*
" constrictum, *Schütt*	*	..	*	..	*	*															
" Gladiolus, *Stein*	*																				
" reticulatum, *Schütt*	..	..	*	..	*																
" tessellatum, *Schütt*	..	..	..	..	..	*	..	..	..	*	..	..	..	..	..	..	..	*	..	..	*
Ceratocorys horrida, *Stein*	..	..	*	..	*	*	*	*	*	*	*	..	*	*	*	*	*	*	*	*	*
" spinifera, *Murr. & Whitt.*	..	..	.	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	
Phalacroma operculatum, *Stein*	*	*	*	*	*	*	..	..	..	*	..	*	..	*	*	..	*	*	*	*	*
" doryphorum, *Stein*	..	*	*	*	*	*	*	..	*	*	..	..	*	*	*	..	*	*	*	*	*
" Mitra, *Schütt*	..	*	*	..	*	*	..	*	*	*	*	*	*	*	*	..	*	*	*	*	*
" Blackmani, *Murr. & Whitt.*	..	..	*	*	*	*	..	..	*	..	..	..	*	..	..	..	..	..	..	*	
" Hindmarchii, *Murr. & Whitt.*	..	..	*	..	*	*															
" dolichopterygium, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	..	*	
Dinophysis Homunculus, *Stein*	*	*	*		..	..	.	..	..	*	*	*	*	*	..	*	*				
" hastata, *Stein*	*																				
" sphærica, *Stein*	..	..	*	*																	
" uracantha, *Stein*	..	..	*	..	*	*	..	..	..	*	*	*	..	*	*	..	*	..	..	..	
Histioneis magnifica, *Murr. & Whitt.*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
" splendida, *Murr. & Whitt.*	..	..	*	..	*	*	*	..	..	..	..	..	..	..	..	..	..	..	..	*	*
" Francescæ, *G. Murr.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	*
" biremis, *Stein*	..	..	*	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	*	*
" crateriformis, *Stein*	..	..	*	..	..	..	..	..	..	*	..	..	..	..	..	..	*	..	..	..	
" remora, *Stein*	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	
" Mitchellana, *Murr. & Whitt.*	..	..	*	*	*	*	..	..	..	..	..	..	..	..	..	*	..	*	..	*	*
" Para, *Murr. & Whitt.*	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*
" Helenæ, *Murr. & Whitt.*	..	..	*	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	*	*
" Dolon, *Murr. & Whitt.*	..	..	..	..	*																
" dentata, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..											
" Milneri, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*
" Highleii, *Murr. & Whitt.*	..	..	*	..	*	..	..	..	..	..	..	..	..	..	..	..	*	..	..	*	
Citharistes regius, *Stein*	..	..	*																	*	*
" Apsteinii, *Schütt*	..	..	..	..	*	*	..	..	..	..											
Amphisolenia palmata, *Stein*	..	..	..	..	*						..	..	..	..	..	..	..	..	..	*	*
" Thrinax, *Schütt*	..	..	..	..	*																
Pyrocystis Noctiluca, *J. Murr.*	..	..	..	*	..	*	..	..	*	*	..	..	..	..	*	..	..	..	..	*	*
" fusiformis, *J. Murr.*	..	*	..	*	*	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	*
" Lunula, *Schütt*	..	*	*	*	*	*	..	..	..	..	..	..	..	..	*	..	..	..	..	*	*
" bicornis, *Blackm.*	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*		
Halosphæra viridis, *A. Schmidt*	*	*	*	*	*	*	..	..	..	..	*	..	..	..	..	..	..	..	..	*	*

TABLE VIII.—R.M.S. 'ATRATO,' VOYAGE II. (CAPT. MILNER).

	Lat. 38°–36° 10′ N., long. 25°–28° 20′ W. Temp. 60°. Jan. 30–31.	Lat. 35°–33° 40′ N., long. 29° 50′–31° 20′ W. Temp. 62°. Jan. 31.	Lat. 33° 40′–31° 50′ N., long. 31° 20′–34° 20′ W. Temp. 62°. Jan. 31–Feb. 1.	Lat. 31° 30′–29° 50′ N., long. 34° 40′–37° W. Temp. 64°–67°. Feb. 1.	Lat. 28° 20′–27° 10′ N., long. 39° 20′–41° 10′ W. Temp. 67°–70°. Feb. 2.	Lat. 27° 10′–25° 30′ N., long. 41° 20′–43° 40′ W. Temp. 70°. Feb. 2–3.	Lat. 24° 10′–22° 10′ N., long. 45° 20′–48° W. Temp. 71°–75°. Feb. 3–4.	Lat. 20° 40′–19° N., long. 50°–52° W. Temp. 76°. Feb. 4–5.	Lat. 14°–16° N., long. 62° 30′–68° W. Temp. 79°. Feb. 8–9.	Lat. 18° N., long. 71°–76° W. Temp. 78°. Feb. 10–11.	Lat. 14°–17° 30′ N., long. 77° W. Temp. 79°. Feb. 26–27.	Lat. 14°–16° N., long. 64°–68° W. Temp. 79°. March 3–4.	Lat. 29° 20′–31° 20′ N., long. 44° 50′–42° 30′ W. Temp. 67°. March 9–10.	Lat. 34°–39° N., long. 39° 30′–32° 30′ W. Temp. 66°–60°. Mar. 10 & 12 (mixed).	Lat. 40° 30′–42° 10′ N., long. 29° 10′–22° 30′ W. Temp. 59°–57°. March 12–13.	Lat. 43° 30′–44° 40′ N., long. 22°–19° W. Temp. 54°. March 13–14.
	1	2	3	4	5	6	7	8	9	10	16	20	21	22	23	24
Ptychodiscus Noctiluca, *Stein*	..	..	..	..	*	..	..	..	*	..	..	*				
Pyrophacus Horologium, *Stein*	..	..	..	..	..	..	..	..	..	..	..	*				
Cladopyxis brachiolata, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	*			
Ceratium Tripos, *Nitzsch*	*	*	*	*	..	*	*	*	*	*	*	*	*	*	*	*
,, Furca, *Dujard.*	..	..	..	..	*	..	..	*	*	*	*	*	*	..	..	*
,, ,, *var.* baltica	..	..	*	*	..	*	..	..	*	*	*	*	*	*	*	
,, Candelabrum, *Stein*	*	..	..	..	*	..	..	*	*	*	*	*	*			
,, Fusus, *Dujard.*	..	*	*	..	..	..	..	..	*	..	..	*	*	*	*	*
,, gravidum, *Gourret*	*	..	..	..	*	..	..	*	*	*	..	*	*			
,, Limulus, *Gourret*	*	*	*	*	*	*	..	..	*	..	..	*	*	*		
Gonyaulax polygramma, *Stein*	*	..	..	..	..	..	..	..	..	..	..	*	*	*	*	*
,, Jolliffei, *Murr. & Whitt.*	..	..	..	..	*	..	..	..	..	*	*	*	*	*		
,, Highlei, *Murr. & Whitt.*	..	..	..	*	*											
,, glyptorhynchus, *Murr. & Whitt.*	..	..	*	..	..	..	..	..	..	..	..	*	*			
Goniodoma acuminatum, *Stein*	*	*	*	*	..	..	..	*	*	*	*	*	*	*	*	
,, sphæricum, *Murr. & Whitt.*	..	*	..	..	*	*	..	..	..	..	..	..	*			
,, Milneri, *Murr. & Whitt.*	..	..	..	..	..	..	..	*	*	*	..	*	*	*		
,, fimbriatum, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	*	..	..	*	..	*	
Diplopsalis sæcularis, *Murr. & Whitt.*	..	..	*	..	*	..	..	..	..	..	..	*	*	*		
Peridinium divergens, *Ehrenb.*	*	*	..	*	*	..	..	*	..	*	*	*	*	*	*	
,, Michaelis, *Ehrenb.*	..	..	*	..	*	..	..	..	..	..	..	*	..	*		
,, tristylum, *Stein*	..	..	..	..	*											
,, Hindmarchii, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	*	..	*		
,, Globulus, *Stein*	*	*	..	..	..	..	..	*	*	*	..	..	*	*	*	*
,, spinulosum, *Murr. & Whitt.*	..	*	..	..	..	..	..	..	..	..	..	..	..	*		
,, sphæricum, *Murr. & Whitt.*	..	..	..	..	*	..	..	..	..	..	..	..	*			
,, leiorhynchum, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	*		
,, reticulatum, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	*		
,, Milneri, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	*			
,, Tripos, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	*			
,, Doma, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	*		
Podolampas bipes, *Stein*	*	*	*	*	*	*	*	*	*	*	*	*	*			
,, palmipes, *Stein*	..	*	*	*	*	..	..	..	*	*	*	*	*	*		
Amphidoma Nucula, *Stein*	*	..	*	*	*	*	..	..	*	*	..	..	*	*	*	*
Oxytoxum Scolopax, *Stein*	*	*	*	*	*	*	..	..	*	*	*	*	*	*	*	*
,, reticulatum, *Schütt*	..	..	..	..	*	..	..	..	..	..	..	..	*	..	..	*
,, tessellatum, *Schütt*	*	*	*	..	..	*	..	*	..	..	..	..	*	*		
,, diploconus, *Stein*	..	..	..	..	*	..	..	..	..	..	..	..	..	*		
,, sphæroideum, *Stein*	..	..	*	*	..	..	..	..	..	..	..	..	*	..	..	*
,, Milneri, *Murr. & Whitt.*	..	..	*	*	*	*	..	*	..	..	..	*	*	*		
,, constrictum, *Schütt*	..	*	*	..	*	..	..	..	..	..	..	..	*	..	..	*
Ceratocorys horrida, *Stein*	..	..	*	..	..	*	..	..	*	*	*	*	*			
,, spinifera, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	*	..	..	*			
Phalacroma operculatum, *Stein*	*	*	*	..	*	*	*	*	..	*	*	*	*	*	*	
,, doryphorum, *Stein*	*	*	*	*	*	*	..	*	*	*	*	*	*	*		
,, dolichopterygium, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	*		
,, Mitra, *Schütt*	*	*	..	..	..	..	..	..	..	*	*	*	*	*		
,, Hindmarchii, *Murr. & Whitt.*	..	..	..	..	*	*	..	..	..	..	..	*				
,, Blackmani, *Murr. & Whitt.*	..	..	..	..	*	*	..	..	..	*	..	*	*	*		
Dinophysis rotundata, *Clap. & Lachm.*	..	..	*	*	*	..	..	..	*	..	..	..	*			
,, sphærica, *Stein*	..	*	..	..	..	..	..	..	..	..	..	*	*			
,, acuta, *Ehrenb.*	..	..	..	..	..	..	..	..	..	..	..	..	*			
,, uracantha, *Stein*	..	..	..	..	*	*	..	*	..	..	..	*	*	*	..	*
,, Homunculus, *Stein*	*	*	*	..	..	..	..	..	..	*	..	..	*	*	*	*
,, Schuettii, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	*			
Amphisolenia palmata, *Stein*	*	*	*	*	*	*	..	..	*	*	..	*	*	*		
,, bifurcata, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	*			
,, globifera, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	*		
,, Thrinax, *Schütt*	..	..	..	..	..	*	..	..	..	..	..	..	*			
,, inflata, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	*		
Histioneis splendida, *Murr. & Whitt.*	..	..	..	*	..	*	*	*	..	..	..	..	*			
,, magnifica, *Murr. & Whitt.*	*	*	*	*	..	*	*	*	*	*	*	*	*	*		
,, remora, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	*			
,, biremis, *Stein*	..	..	..	..	..	..	..	..	..	*	*	*	*			
,, Highlei, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	*			
,, Mitchellana, *Murr. & Whitt.*	..	..	..	*	..	*	..	..	..	..	..	..	*			
,, crateriformis, *Stein*	..	*	*	*	..	*	..	..	*	..	..	..	*			
,, Para, *Murr. & Whitt.*	..	..	*	..	..	*	..	..	..	..	..	..	*			
,, Dolon, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	*			
,, Helenæ, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	*				
,, Francescæ, *G. Murr.*	..	..	..	..	..	*	..	..	..	..	..	*	*			
,, Milneri, *Murr. & Whitt.*	..	*	..	..	..	..	..	..	..	..	*	..				
Citharistes Apsteinii, *Schütt*	..	..	..	..	*	*	..	*	..	..	..	*	*	*		
——																
Pyrocystis Noctiluca, *J. Murr.*	..	..	*	*	*	*	..	*	*	..	..	*				
,, Lunula, *Schütt*	..	*	*	*	*	*	..	*	*							
,, fusiformis, *J. Murr.*	*	*	*	*	*	*	..	*	..	..	..	*				
,, bicornis, *Blackm.*	..	..	..	..	..	*										

TABLE IX.—R.M.S. 'ATRATO,' Voyage III. (Capt. Milner).

	1	2	3	4	5	6	8	9	10	11	12	17	18	20	21	22	23	24	25	27	28
	Lat. 41°–39° 10′ N., long. 20° 10′–23° W. Temp. 60°. April 9–10, 1898.	Lat. 38° 30′–35° 50′ N., long. 23° 50′–28° 10′ W. Temp. 60°–62°. April 10–11.	Lat. 35° 50′–32° 20′ N., long. 28° 10′–33° 40′ W. Temp. 63°–65°. April 11–12.	Lat. 32° 20′–28° 50′ N., long. 33° 40′–38° 20′ W. Temp. 65°–68°. April 12–13.	Lat. 28° 50′–25° 40′ N., long. 38° 20′–43° W. Temp. 68°–69°. April 13–14.	Lat. 25° 40′–22° 20′ N., long. 43°–47° 30′ W. Temp. 69°–70°. April 14–15.	Lat. 22° 20′–19° 10′ N., long. 47° 30′–51° 50′ W. Temp. 70°–76°. April 15–16.	Lat. 19° 10′–16° N., long. 51° 50′–56° W. Temp. 77°. April 16–17.	Lat. 16°–14° 30′ N., long. 56°–58° W. Temp. 78°. April 17.	Lat. 14°–15° 30′ N., long. 63° 30′–67° 10′ W. Temp. 78°. April 19–20.	Lat. 16° 20′–17° 20′ N., long. 69° 30′–72° W. Temp. 80°. April 20–21.	Lat. 13°–17° N., long. 76° W. Temp. 81°. May 7–8.	Lat. 17° 30′–15° 50′ N., long. 68°–70° W. Temp. 81°. May 11–12.		Lat. 16°–20° N., long. 58°–54° W. Temp. 80°–78°. May 15–16.	Lat. 22°–24° N., long. 53°–51° W. Temp. 71°. May 16–17.	Lat. 27°–28° 30′ N., long. 49°–47° W. Temp. 71°. May 17–18.	Lat. 30° 30′–32° N., long. 44° 30′–42° W. Temp. 70°. May 18–19.	Lat. 33°–34° N., long. 42°–40° W. Temp. 70°. May 19.	Lat. 43°–44° N., long. 23°–20° W. Temp. 62°–58°. May 22–23.	Lat. 44° 30′–47° N., long. 19°–13° 30′ W. Temp. 58°–55°. May 23–24.
Ptychodiscus Noctiluca, *Stein*	..	*	..	..	*	*	*	..	..	..	*	..	..	*	..	..	*				
Pyrophacus Horologium, *Stein*	..	*	..	..	..	..	*	..	*												
Cladopyxis brachiolata, *Stein*	..	..	..	..	..	..	*														
Ceratium Tripos, *Nitzsch*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	..	*	*	..	*
" Furca, *Dujard.*	..	..	..	..	..	..	..	..	*	..	..	..	..	..	*	*	..	..	..	..	*
" " *var.* baltica	*	*	*	*	*	..	*	*	*	..	*	*	..	*	..	*	..	*	..	..	*
" Candelabrum, *Stein*	..	..	..	*	*	..	..	..	*	*	*	..	..	*	*	..	..	..	*		
" Fusus, *Dujard.*	*	*	..	*	*	*	..	*	*	*	..	..	..	..	..	..	..	..	*	..	*
" gravidum, *Gourret*	..	..	..	..	..	..	..	*	..	..	*	..	..	*							
" Limulus, *Gourret*	*	*	..	..	*	*	..	*	..	*	..	..	..	*	*	*	..	*			
" digitatum, *Schütt*	..	..	..	..	..	..	..	..	..	..	*										
Gonyaulax polygramma, *Stein*	..	..	..	*	*	*	*	*	..	*	*	..	*	*	*	*	..	*	*	..	*
" Jolliffei, *Murr. & Whitt.*	*	*	..	*	*	*	..	*	*	*	*	..	..	*	..	..	..	*			
" Highlei, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*					
" glyptorhynchus, *Murr. & Whitt.*	..	..	..	..	*	..	..	..	..	..	..	..	..	..	*						
" Turbynei, *Murr. & Whitt.*	..	..	..	..	*	..	*	..	..	..	*	..	..	..	..	..	..	*	*	..	*
Goniodoma acuminatum, *Stein*	*	*	..	*	..	*	*	*	*	..	*	*	*	*	*	*	*	*	*	*	*
" Milneri, *Murr. & Whitt.*	..	..	..	..	..	*	*	*	*	*	..	..	*	..	*	*	*	*			
" fimbriatum, *Murr. & Whitt.*	*	..	..	..	..	*	..	..	..	..	..	..	..	..	*	*	*	*	*		
Diplopsalis sæcularis, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	*		
Peridinium divergens, *Ehrenb.*	*	*	*	*	*	*	*	..	*	*	*	*	*	*	*	..	*	*	*	*	*
" Globulus, *Stein*	*	..	*	*	..	..	..	*	*	..	..	*	*	*	..	*	..	*	*	*	*
" Michaelis, *Ehrenb.*	*	*	..	..	*	..	..	*	..	..	*	..	..	..	*	..	..	..	*		
" sphæricum, *Murr. & Whitt.*	..	..	..	..	*																
" Hindmarchii, *Murr. & Whitt.*	..	..	..	..	..	..	*	*													
" spinulosum, *Murr. & Whitt.*	..	..	..	..	..	*	..	*	..	..	..	..	..	..	..	*					
" Blackmani, *Murr. & Whitt.*	..	..	..	..	..	..	*	*													
" reticulatum, *Murr. & Whitt.*	.	..	..	..	..	..	*	*													
" Tripos, *Murr. & Whitt.*	..	..	..	..	*	..	..	*	*												
" leiorhynchum, *Murr. & Whitt.*	..	..	..	..	..	..	*														
" vexans, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*
Podolampas bipes, *Stein*	*	..	..	*	*	*	*	*	*	*	*	*	*	..	*	*	*	*			
" palmipes, *Stein*	..	..	*	..	*	..	..	*	..	..	*	*	..	..	..	..	*	*	*		
Amphidoma Nucula, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	*	..	*	..	..	..	..	*	
Oxytoxum Scolopax, *Stein*	*	*	*	*	*	*	*	*	..	..	..	*	*	..	*	..	..	*	*	*	*
" reticulatum, *Schütt*	..	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	*			
" tessellatum, *Schütt*	..	..	..	*	..	*	*	..	..	*	..	..	..	..	..	..	..	..	*		
" sphæroideum, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	*		
" Milneri, *Murr. & Whitt.*	..	..	..	..	..	..	*	*	*	..	..	..	..	..	*	*	..	*	*		
" constrictum, *Schütt*	..	..	..	..	*	*	..	*	..	..	..	..	..	..	..	..	..	..	*	*	
" Sceptrum, *Schütt*	..	..	*	..	..	*	..	..	..	..	..	..	..	*	..	..	..	..	..	..	*
Ceratocorys horrida, *Stein*	..	..	..	*	..	..	*	*	*	*	*	..	..	..	*	*	*	*			
" spinifera, *Murr. & Whitt.*	..	..	..	..	..	..	..	*	..	*	..	..	..	..	*	..	..	*			
Phalacroma operculatum, *Stein*	*	*	*	..	..	*	*	*	*	*	*	*	*	..	..	*	*	*	..	..	*
" doryphorum, *Stein*	*	..	..	..	..	*	*	*	..	*	*	..	*	*	*	*	*	*			
" dolichopterygium, *Murr. & Whitt.*	..	..	*	*	..	..	..	..	*												
" Mitra, *Schütt.*	..	..	..	..	..	..	*	*	..	*	..	*	..	*	..	*	..	*			
" Blackmani, *Murr. & Whitt.*	..	..	..	..	..	*	*	*													
" Hindmarchii, *Murr. & Whitt.*	..	..	..	..	..	..	*														
Dinophysis rotundata, *Clap. & Lachm.*	*	..	..	..	*	*	..	..	..	*	..	..	*	..	..	..	*	*	*		
" sphærica, *Stein*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*
" acuta, *Ehrenb*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*		
" uracantha, *Stein*	..	..	..	..	..	..	..	*													
" Homunculus, *Stein*	*	*	*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	*	*	*	*
Amphisolenia palmata, *Stein*	..	..	..	..	*	*	*	*	..	*	*	*	*	*	*						
" bifurcata, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	*	*										
Histioneis magnifica, *Murr. & Whitt.*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	..	*	*	*	*	*	
" Francescæ, *G. Murr.*	..	..	..	..	*	..	*	*													
" Para, *Murr. & Whitt.*	..	..	..	..	*	*	..	*													
" Highlei, *Murr. & Whitt.*	..	..	..	..	*																
" biremis, *Stein*	..	..	..	..	*	*	..	..	..	*											
" Milneri, *Murr. & Whitt.*	..	..	..	..	..	*															
" Helenæ, *Murr. & Whitt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	*							
" Mitchellana, *Murr. & Whitt.*	..	..	..	..	*	..	*	..	..	..	..	..	*								
" crateriformis, *Stein*	..	..	..	..	*	*	*														
" remora, *Stein*	..	..	..	..	*	..	..	..	..	..	*										
Citharistes Apsteinii, *Schütt*	..	..	..	..	..	..	..	*	..	..	*										
Pyrocystis Noctiluca, *J. Murr.*	..	..	..	..	.	*	..	*													
" Lunula, *Schütt*	*	..	*	..	*	*	*	*	*												
" fusiformis, *J. Murr.*	..	..	..	..	*	*															
" bicornis, *Blackm.*	.	..	..	..	..	..	..	..	*	*											

EXPLANATION OF THE PLATES.

Plate XXVII.

Fig. 1. *Goniodoma fimbriatum*, Murr. & Whitt.: *a*, ventral view; *b*, dorsal view. × 840.

Fig. 2. *Goniodoma Milneri*, Murr. & Whitt.: *a*, side view; *b*, ventral view; *c*, encysted form opening; *d*, the same closed. × 420.

Fig. 3. *Goniodoma sphæricum*, Murr. & Whitt.: *a*, ventral view; *b*, view of proximal limb. × 860.

Fig. 4. *Ceratium biconicum*, Murr. & Whitt.: *a*, dorsal view; *b*, ventral view; *c*, side view. × 400.

Fig. 5. *Ptychodiscus Noctiluca*, Stein: *a*, view of proximal limb; *b*, dorsal view; *c*, var. *fimbriatus*, view of proximal limb. × 760.

Fig. 6. *Oxytoxum Milneri*, Murr. & Whitt. × 530.

Fig. 7. *Oxytoxum constrictum*, Schütt. × 860.

Plate XXVIII.

Fig. 1. *Gonyaulax Jolliffei*, Murr. & Whitt.: *a*, dorsal view; *b*, ventral view. × 470.

Fig. 2. *Gonyaulax Highlei*, Murr. & Whitt.: *a*, ventral view; *b*, dorsal view. × 840.

Fig. 3. *Gonyaulax glyptorhynchus*, Murr. & Whitt.: *a*, dorsal view; *b*, ventral view; *c*, ventral view of form varying as to spine on proximal limb. × 840.

Fig. 4. *Gonyaulax Turbynei*, Murr. & Whitt.: *a*, ventral view; *b*, dorsal view. × 840.

Fig. 5. *Diplopsalis sæcularis*, Murr. & Whitt.: *a*, ventral view; *b*, distal limb; *c*, *d*, *e*, *f*, views of forms varying from the typical one represented in *a* and *b*. × 420.

Plate XXIX.

Fig. 1. *Peridinium Hindmarchii*, Murr. & Whitt.: *a*, dorsal view; *b*, ventral view. × 500.

Fig. 2. *Peridinium leiorhynchum*, Murr. & Whitt.: *a*, ventral view; *b*, lateral view. × 600.

Fig. 3. *Peridinium Milneri*, Murr. & Whitt.: *a*, dorsal view; *b*, ventral view. × 840.

Fig. 4. *Peridinium divergens*, Ehrenb.: *a*, dorsal view; *b*, ventral view of variety. × 500.

Fig. 5. *Peridinium trirostre*, Murr. & Whitt.: ventral view. × 420.

Fig. 6. *Peridinium Blackmani*, Murr. & Whitt.: *a*, dorsal view; *b*, side view; *c*, ventral view. × 370.

Fig. 7. *Peridinium vexans*, Murr. & Whitt.: *a*, ventral view; *b*, dorsal view. × 840.

Fig. 8. *Peridinium spinulosum*, Murr. & Whitt. × 600.

Plate XXX.

Fig. 1. *Peridinium sphæricum*, Murr. & Whitt.: *a*, dorsal view; *b*, ventral view. × 860.

Fig. 2. ? *Peridinium Globulus*, Stein. × 860.

Fig. 3. *Peridinium Doma*, Murr. & Whitt.: ventral view. × 800.

Fig. 4. *Peridinium Tripos*, Murr. & Whitt.: *a*, dorsal view; *b*, ventral view. × 840.

Fig. 5. *Ceratocorys horrida*, Stein: *a*, side view; *b*, encysted. × 420.

Fig. 6. *Ceratocorys spinifera*, Murr. & Whitt.: *a*, ventral view; *b*, dorsal view (both × 840); *c*, proximal limb, young state (× 620); *d*, proximal limb, mature state (× 410); *e*, form with two spines only (× 840).

Plate XXXI.

Fig. 1. *Amphisolenia bifurcata,* Murr. & Whitt.: *a,* complete (× 160); *b,* ventral view; *c,* side view; *d, e,* terminations of proximal limb (× 610).

Fig. 2. *Amphisolenia inflata,* Murr. & Whitt.: *a,* lateral view; *b,* ventral view. × 420.

Fig. 3. *Citharistes Apsteinii,* Schütt: *a,* side view; *b,* ventral view. × 840.

Fig. 4. *Phalacroma Blackmani,* Murr. & Whitt.: *a,* view of distal limb; *b,* side view. × 420.

Fig. 5. *Phalacroma Hindmarchii,* Murr. & Whitt.: side view. × 500.

Fig. 6. *Phalacroma Rudgei,* Murr. & Whitt.: *a,* side view; *b,* ventral view. × 420.

Fig. 7. *Phalacroma Mitra,* Schütt: side view. × 420.

Fig. 8. *Phalacroma dolichopterygium,* Murr. & Whitt.: *a,* side view; *b,* ventral view. × 410.

Fig. 9. *Dinophysis Rudgei,* Murr. & Whitt.: *a,* side view; *b,* optical section. × 500.

Fig. 10. *Dinophysis Schuettii,* Murr. & Whitt. × 840.

Plate XXXII.

Fig. 1. *Histioneis splendida,* Murr. & Whitt.: *a,* side view; *b,* ventral view; *c,* view of distal limb, &c. × 310.

Fig. 2. *Histioneis magnifica,* Murr. & Whitt.: side view. × 500.

Fig. 3. *Histioneis Francescæ,* G. Murr.: side view. × 680.

Fig. 4. *Histioneis Para,* Murr. & Whitt.: *a,* side view; *b,* ventral view; *c,* side view of form with sail varying from type. × 680.

Fig. 5. *Histioneis Highlei,* Murr. & Whitt. × 620.

Fig. 6. *Histioneis biremis,* Stein: side view. × 420.

Plate XXXIII.

Fig. 1. *Histioneis Milneri,* Murr. & Whitt.: *a,* side view; *b,* ventral view. × 420.

Fig. 2. *Histioneis Helenæ,* Murr. & Whitt.: *a,* side view; *b,* ventral view. × 420.

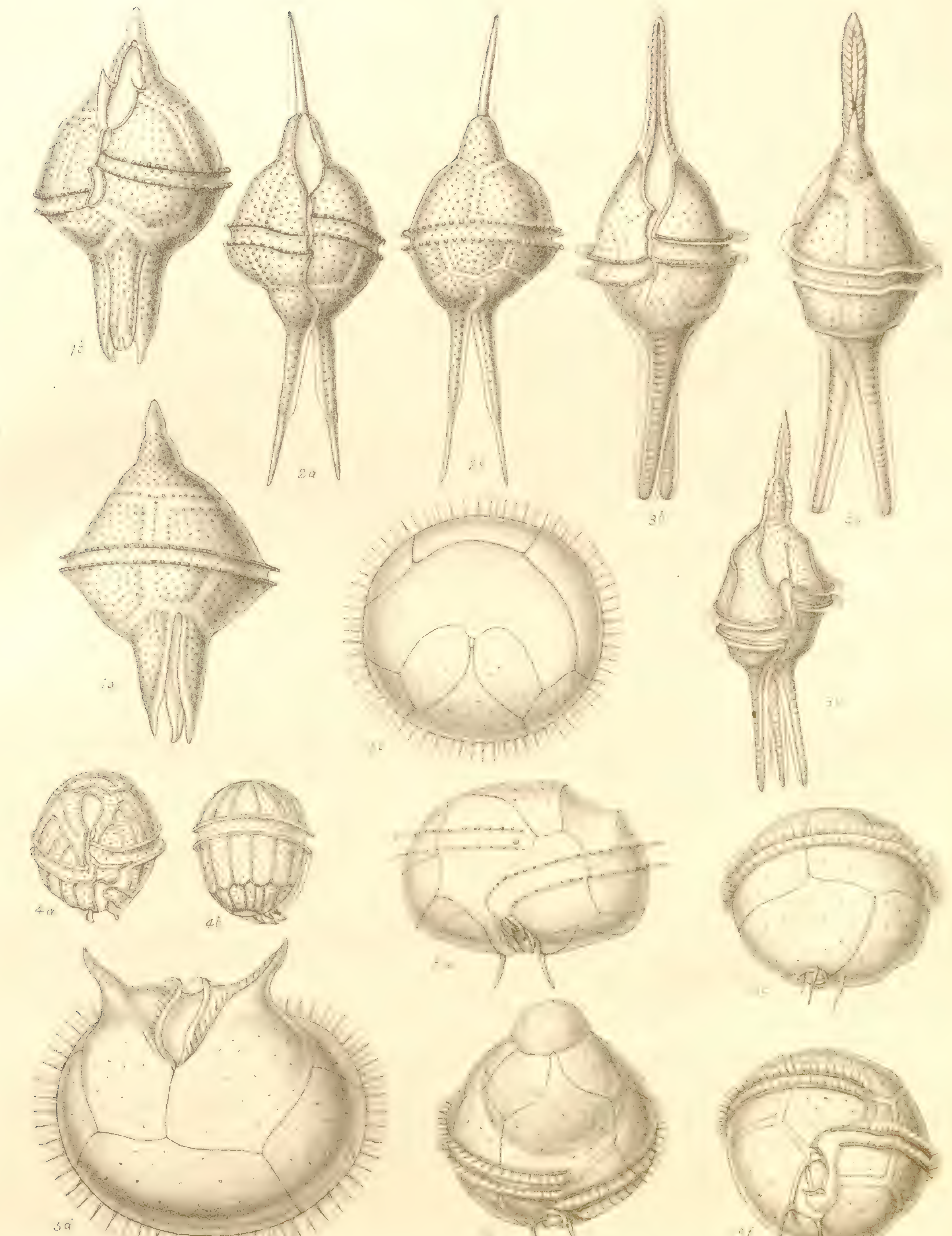
Fig. 3. *Histioneis Mitchellana,* Murr. & Whitt.: *a,* side view; *b,* ventral view. × 600.

Fig. 4. *Histioneis dentata,* Murr. & Whitt. *a,* side view; *b,* ventral view. × 840.

Fig. 5. *Histioneis Dolon,* Murr. & Whitt.: *a,* side view; *b,* ventral view. × 600.

Hanhart imp

NEW PERIDINIACEÆ



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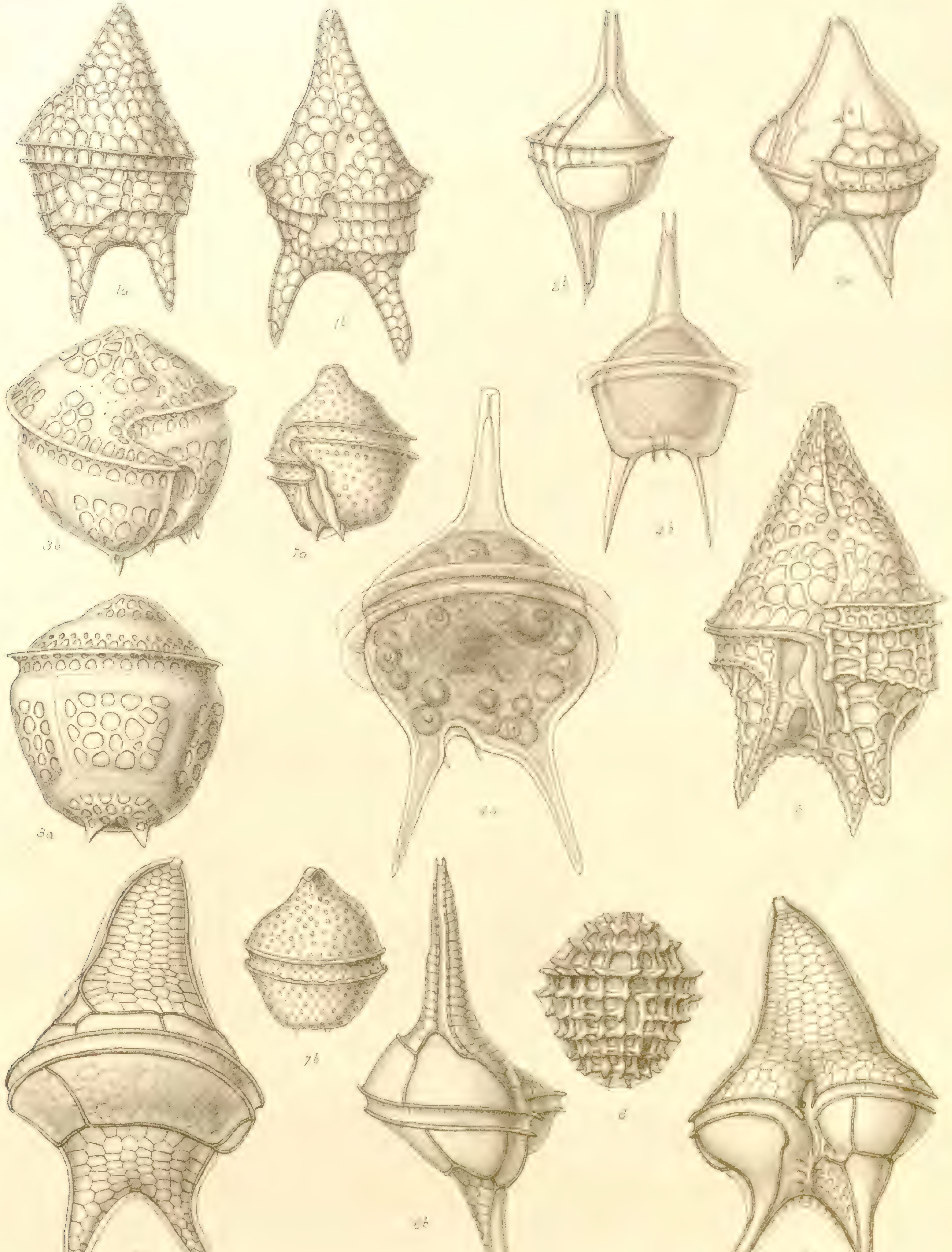

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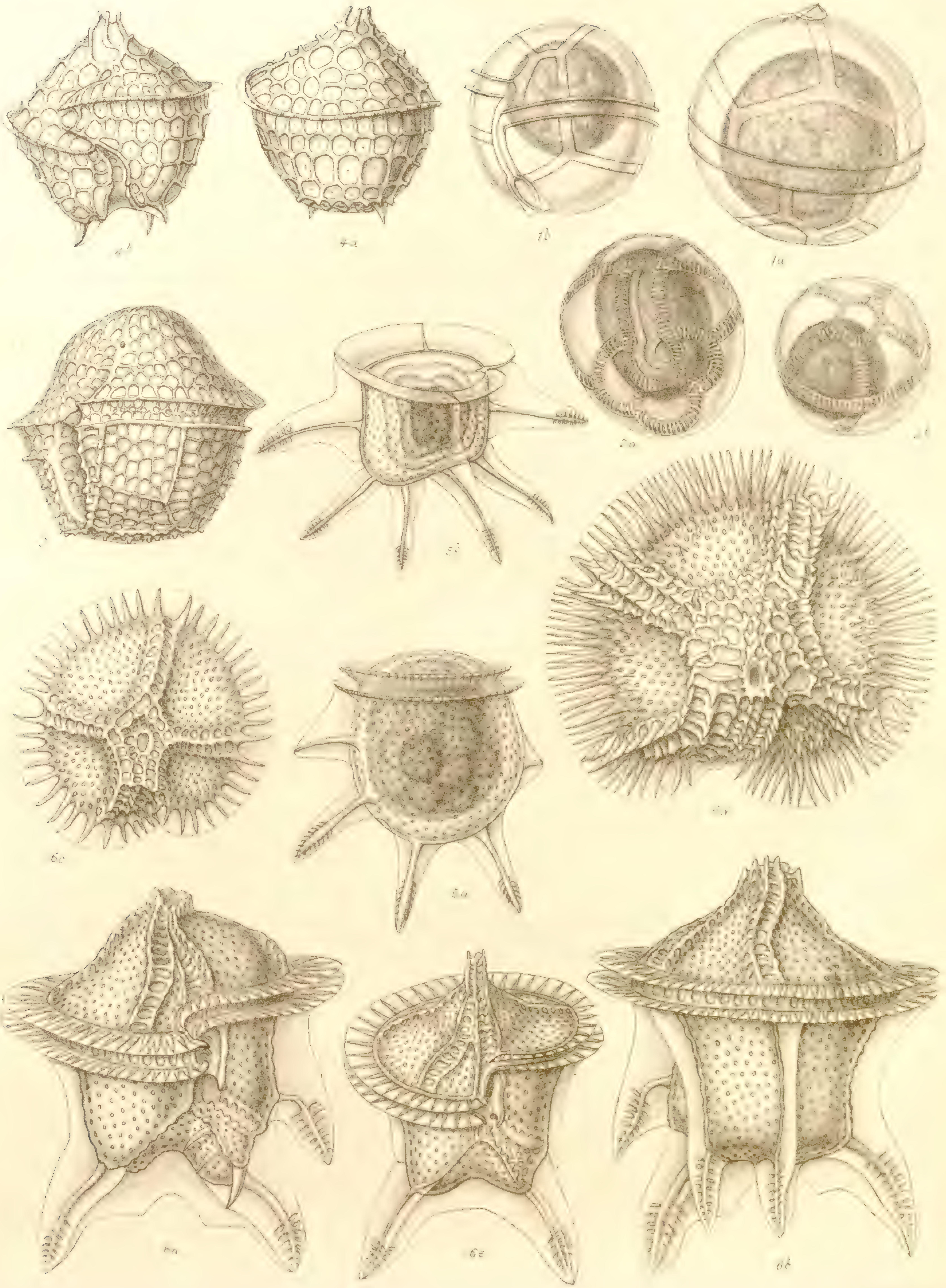

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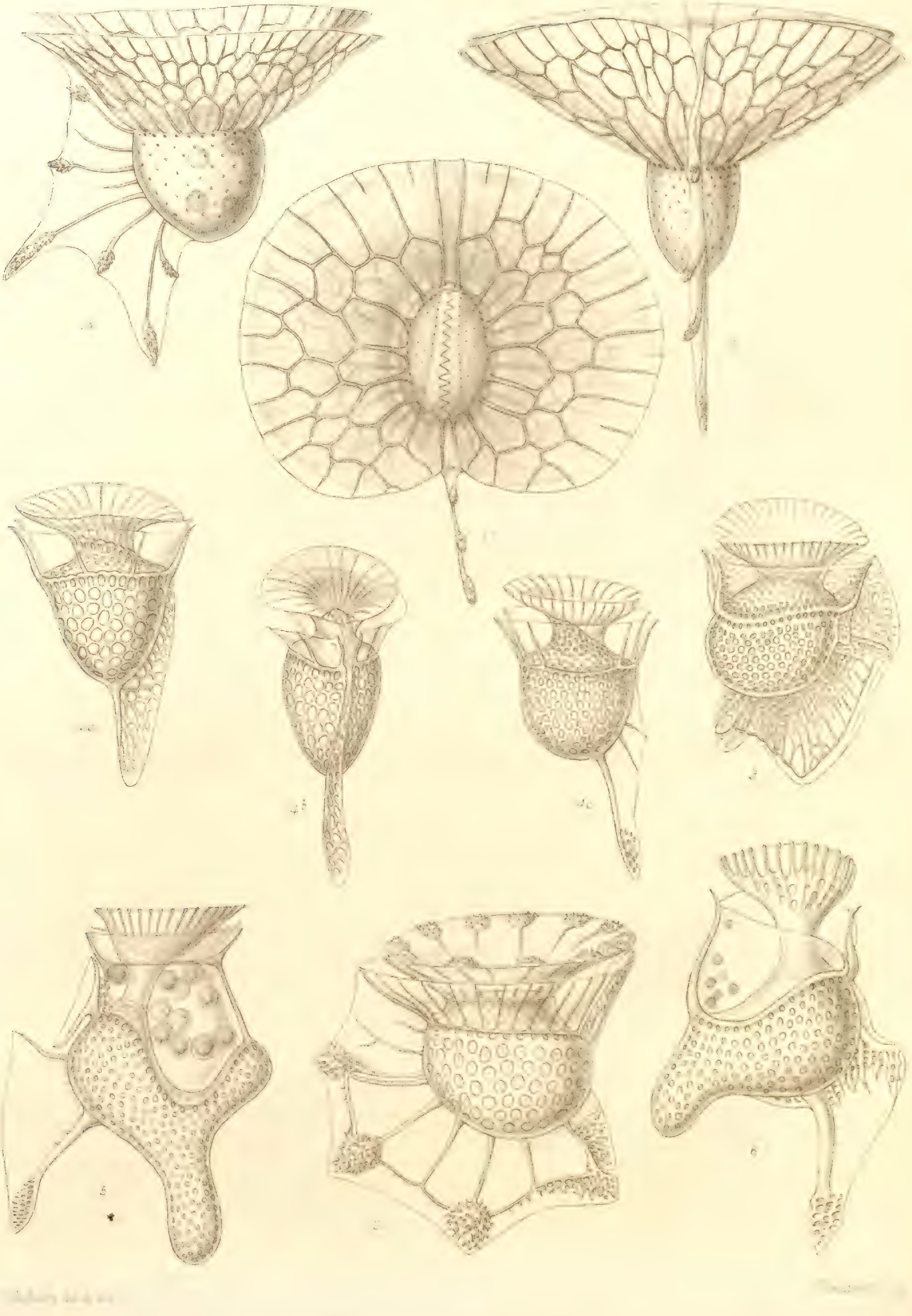

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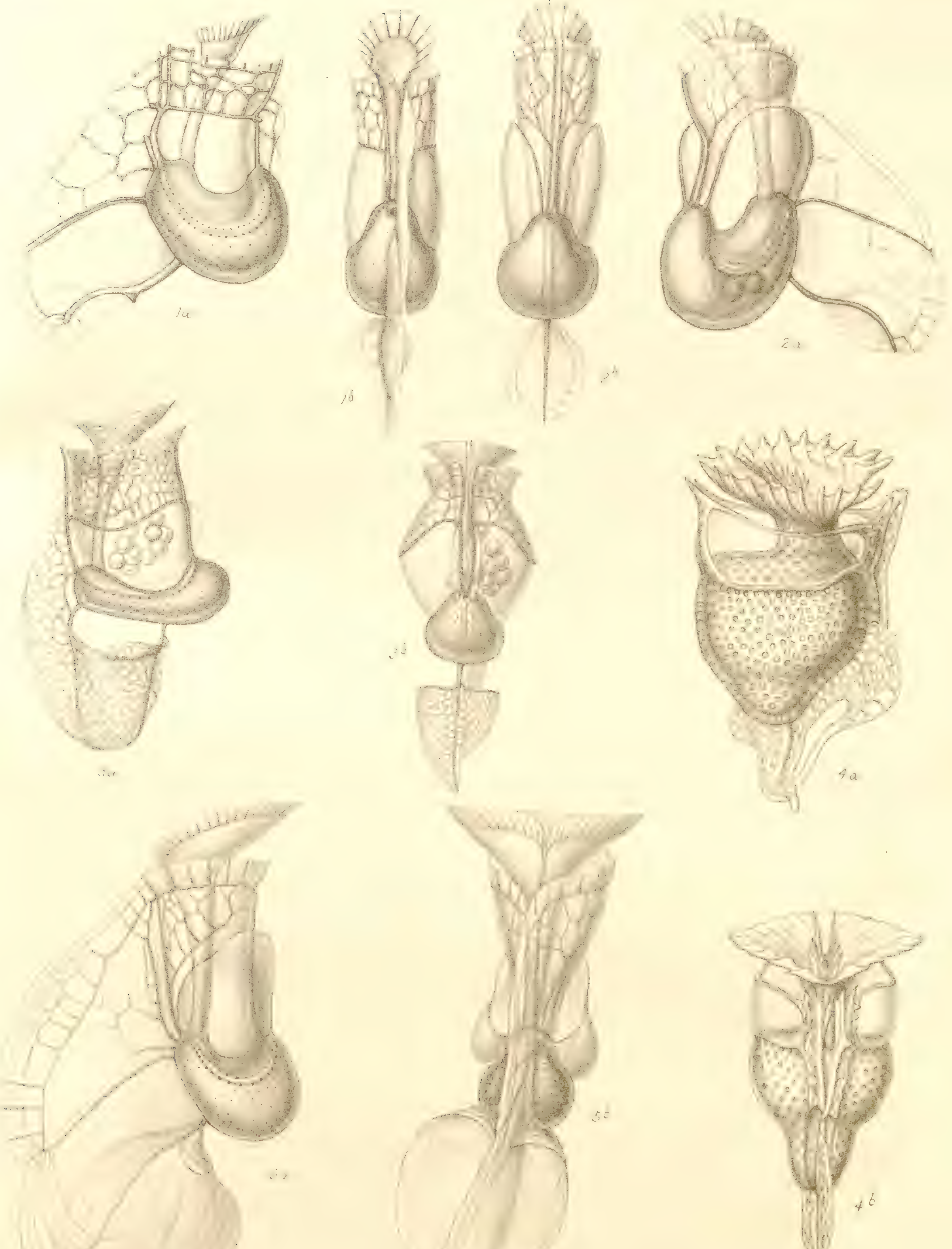

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LINNEAN SOCIETY OF LONDON.

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THE

TRANSACTIONS

OF

THE LINNEAN SOCIETY OF LONDON.

ON CRATEROSTIGMA PUMILUM, *Hochst.*,
A RARE PLANT FROM SOMALI-LAND.

BY

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April 1899.

X. *On* Craterostigma pumilum, *Hochst., a rare Plant from Somali-Land. By* H. Marshall Ward, *D.Sc., F.R.S., F.L.S., Professor of Botany in the University of Cambridge, and* Miss E. Dale, *Pfeiffer Student, Girton College.*

(Plates XXXIV. & XXXV.)

Read 3rd November, 1898.

In May 1897 a number of living plants collected in Somali-Land were received at the Cambridge Botanic Garden from Mrs. Lort Phillips, who presented them to this University. Among these was the following, and as it has flowered several times with us this summer, and has now (July 1898) ripened its first capsule of seeds *, we are able to give a fairly complete account of it even from the comparatively small quantity of material at our disposal.

It is a herbaceous perennial, the general habit, size, and mode of flowering of which remind one of a *Pinguicula*, though it is very different in details, as will be shown (Pl. XXXIV. fig. 1): but perhaps its most striking feature is the roots, to which our attention was drawn by Mr. Lynch long before the plant flowered; these are bright coral-red or scarlet, like vermilion sealing-wax, and present a startling contrast to the black soil used when repotting the plants.

Various suggestions have been entertained as to the best mode of growing the plant; on the whole it seems to do best in the Water-lily House, close to the glass.

The external features of the adult flowering plant may be described as follows:—

Roots numerous, fibrous, rather thick, and slightly branched, arising from the underside of the rhizome and the bases of older leaves; white when young, the older ones scarlet with white tips. (Figs. 1 & 2, Pl. XXXIV.)

Stem a short, red, oblique or horizontal, creeping, subterranean rhizome, giving off roots below and rough with crowded leaf-scars above. It is terminated by a rosette of leaves at the surface of the ground, and gives off similar rosettes as lateral buds or offsets from the axils of the lowermost leaves. These offsets afford a ready means of vegetative propagation, soon forming rhizomes ½ to 1 inch long, like the parent stem. (Fig. 2.)

Leaves few, simple, entire, exstipulate, sub-opposite, and crowded into radical rosettes, the internodes being practically obsolete. Lamina rhomboid-oval, and often slightly oblique, obtuse, about 1–1½ inches long; tapering below into a short, broad, flat petiole with a wide insertion, but not sheathing. Margins ciliate, especially when young. Venation somewhat like that of *Plantago*; principal ribs about 7 to 9, thick and

* These have now germinated (March 1899).

prominent beneath, longitudinal and nearly parallel, but converging above and below, and running close together down the petiole, where they are red; smaller veins numerous and reticulate, but sunk and hardly visible in the thick, almost fleshy, lamina. Upper surface of lamina bright green, glabrous, and minutely punctate; lower paler green, finely pilose, streaked with red at the base.

Flowers complete, hermaphrodite, zygomorphic, and solitary, each on an axillary scape; peduncle about $1\frac{1}{2}$ to 2 inches long, leafless, cylindrical, stiff, and erect.

Calyx regular, tubular-campanulate, erect and persistent, about $\frac{1}{4}$ inch long, 5-toothed and slightly 5-ribbed, shortly pilose; the teeth obtuse ciliate. Not winged or appreciably plicate. (Fig. 12, Pl. XXXIV.)

Corolla gamopetalous, hypogynous, bilabiate. Tube erect, blue, half as long again as the calyx; limb obliquely horizontal, and consisting of a large, patent, flat, equally three-lobed lower lip, white with blue patches and veins, and a much smaller oblong upper lip, scarcely notched at the tip. Æstivation imbricate, the upper lip external, the right-hand lobe of the lower lip internal and overlapped by the median and left-hand lobes; tube not folded. (Figs. 4–7.)

Stamens 4, didynamous, and with no trace of a fifth; inserted at the throat. The anterior pair longer, their free, white, straight, slender filaments converging forward and upward, and each springing at an acute angle from a yellow, prominent, cushion-like, basal insertion running obliquely across the base of the lower lip and nearly meeting its fellow (figs. 8 & 9); each stamen thus bears a curious resemblance to the leg of an insect. The posterior pair just within the tube, with much shorter filaments inserted directly into the base of the upper lip and converging forwards. Anthers of each pair somewhat connivent, two-lobed and two-celled, and dehiscing by longitudinal slits. Pollen simple.

Ovary superior, of two antero-posterior carpels, two-celled, the posterior chamber the larger; ovoid and completely enclosed in the tube; terminating in a long, thin, exserted style, expanding above to a two-lipped stigma, irritable to contact. (Figs. 6 & 7.) Placentation axile. Ovules small, numerous, anatropous. (Fig. 10.)

Fruit a capsule, cylindric-ovoid, twice the length of the calyx, which it distends and partially splits. Dehiscence septicidal and septifragal, by two vertical valves. (Fig. 12.)

Seeds small, numerous, brown, pitted. Embryo straight, or nearly so, in the axis of a cartilaginous endosperm stored with aleurone. (Figs. 13 & 14.)

The germination is epigeal, the slender hypocotyl carrying the two small oval cotyledons some millimetres above the soil. The first pair of leaves are minute and opposite, and bear numerous hyaline hairs. The red colour appears in the primary roots when only 10–15 mm. long.

The habit and inflorescence of the plant have striking superficial resemblances to those of a *Pinguicula*; the venation is somewhat like that of a *Plantago*, while the corolla reminds one of some Lobelias, and the two-lipped stigma of that of a *Mimulus*.

Analysis of the above characters clearly places this plant in Scrophulariaceæ, and in the tribe Gratioleæ of the Antirrhinoideæ. This tribe contains a good many genera and numerous species of tropical and sub-tropical plants; and among these is the small genus

Craterostigma, founded by Hochstetter ('Flora,' Jahrg. xxiv. p. 668) in 1841 on the two Abyssinian plants *C. plantagineum* and *C. pumilum*, and it is with the latter that our plant agrees.

Of the three or four species comprised in *Craterostigma*, only one has the flowers solitary, viz. *C. pumilum*, Hochst., and it comes from Abyssinia or Somali-Land.

On reference to the Kew Herbarium we found that *Craterostigma pumilum*, Hochst., has inflorescences which are usually branched and bear about three to five flowers with bracts—an umbellate cyme apparently; but on the same sheet is a specimen with single flowers marked *Torenia auriculæfolia*, Dombr., and the closest examination shows no other differences between it and the several-flowered *Craterostigma pumilum*, Hochst., and leads to the conviction that the Kew authorities are right in merging Dombrain's plant in Hochstetter's species. Moreover, there can be no doubt that Dombrain's plant is the same as ours, especially after consulting his figure in 'The Floral Magazine,' 1871, p. 534; but as he gives no botanical description and no figure or mention of the red roots or details, we think it worth while to offer our results.

On the same Kew sheet also there are some multi-flowered specimens collected by Mrs. Lort Phillips, and all the specimens on this sheet show by the red stains that the roots were coloured as in our specimen. The same is true of *C. plantagineum*, Hochst., a much more hairy form, evidently very close to *C. pumilum*, and coming from the same region. The dried herbarium specimens of *C. pumilum* also look more hairy than our fresh plant.

The question arises whether the single-flowered (*auriculæfolium*) form is a constant variety of *C. pumilum*, or merely a more poorly-grown plant: some of the Kew specimens with several flowers are as small as the one-flowered form. We have been unable to detect any bracts on the inflorescence of our Cambridge plant, and Dombrain's figure shows no traces of them.

Internal Structure.

Root.—A transverse section through the root (Pl. XXXIV. fig. 15) shows the usual structure of a central stele surrounded by cortex. The cortical cells are arranged with great regularity in radial rows, and between them are equally symmetrical intercellular spaces, which, in section, are of quadrangular form, and contain a peculiar red colouring-matter. The spaces are in many cases almost as large as the cells, and generally occur throughout the cortex, but are absent from the piliferous layer and the cells immediately internal to it.

When highly magnified (Pl. XXXV. fig. 16) the spaces are seen to be due to the splitting of the middle lamella at the points where four cells would be in contact. Where the walls of adjacent cells are united one to another they are flat, but where they limit a space they project into it, so that, in transverse section, the cells approximate to the form of a square with rounded angles, while the spaces are quadrangular with convex walls. On account of the regularity of the arrangement of the cells, the spaces between them are also very uniform in shape and size.

In thick sections, less highly magnified, the colouring-matter appears to be lying freely in the spaces; but on closer examination it is seen to consist of minute rounded granules or drops, closely packed on the outer walls of the cells to which they are attached.

The cells of the piliferous layer are thin-walled, with the exception of a few of rather smaller size in which the outer wall is thickened (Pl. XXXV. fig. 18). On most of the roots there are extremely few root-hairs.

A radial longitudinal section shows that the intercellular spaces form passages bounded by cells which appear to lie in rows and to have a more or less moniliform outline (Pl. XXXV. fig. 18).

In oblique tangential sections the spaces between the cells in one plane appear to alternate with those separating the cells which lie immediately below. In such a section the colour is seen lying on the surfaces of the walls, and the large amount of it is very striking.

The colouring-matter is not present between the two outer rows of cells, even where the cells of the piliferous layer and that immediately within it are not in uninterrupted contact with one another.

It has been said (p. 343) that the ends of the larger roots and of some of the smaller ones are colourless. A longitudinal section in this region shows that, although the spaces are continuous almost to the apex, the red granules usually end some distance behind the tip, in most cases suddenly. Near the end of some roots the colour is present in patches separated from one another by areas free from granules.

The cells of the cortex in the root contain considerable numbers of colourless bodies, which are evidently leucoplasts (leucoleucites). With iodine they become purple owing to the presence of starch, and are therefore to be regarded as amyloplasts.

If a plant be taken out of the ground and placed in water with its roots exposed to the action of light, the leucoplasts become green, *i. e.* they are changed into chloroplasts (chloroleucites).

The Stele.—There is nothing specially noteworthy, as departing from ordinary types, in the stele. In the centre are thick-walled sclerenchymatous fibres, in many cases still retaining their cell-contents. They are surrounded by about six groups of xylem, alternating with as many groups of phloem, separated from one another by small parenchymatous cells, the whole being enclosed by a not very definite pericycle and endodermis (Pl. XXXV. fig. 17). Immediately beyond the endodermis are cortical cells separated by spaces containing the colour-granules.

A longitudinal tangential section near the outside of the stele shows, even in extremely small roots and in fresh or hardened material, a central group of elongated thin-walled cells with very sinuous longitudinal walls. The most external of these cells, on each side, have always their inner walls sinuous and their outer walls smooth. These cells may perhaps be regarded as endodermal (*cf.* De Bary, 'Comparative Anatomy of the Phanerogams and Ferns,' fig. 50, p. 123).

The Leaf.—A transverse section near the base of the leaf consists of rounded cells of approximately equal size, separated from one another by very irregular spaces

(Pl. XXXV. fig. 22). Some of these spaces are mere points, others are so large that the cells are attached to one another, laterally, by very small surfaces.

From the underside of the leaf, through about half or two-thirds of its entire thickness, the spaces are lined with red granules. The extreme irregularity in the size and form of the spaces in the leaf is shown in Pl. XXXV. fig. 22.

In a longitudinal section the cells appear in rows, which in some parts are in contact, but in others separated by spaces of variable width, and tapering to a point where the cells of adjacent rows are still united. As in the transverse section, the spaces vary greatly in size and form, some appearing as small lenticular slits.

Transverse Section of the Lamina.—The red colour is absent from the upper part of the leaf, which in section differs little from the ordinary bi-facial type (Pl. XXXV. fig. 21).

On the upper side the epidermis consists of larger cells than on the lower. Stomata and glands are present on both surfaces, but they are more numerous on the under side. The palisade parenchyma consists of about four rows of cells, which are only slightly elongated. The cells of the spongy parenchyma are rounded, and connected with one another by elongated processes, bridging over the intercellular spaces.

A surface view of the epidermis shows the stomata and the glands. Seen from above the epidermal cells appear rounded and have undulating walls. The stomata are of the usual type (Pl. XXXV. fig. 23). Round the glands the epidermal cells are somewhat pyriform, with their narrow ends near the gland and their broad ends directed away from it, so that they form a kind of rosette. The reason of this arrangement is that the glands are sunk into pits. It is these pits which cause the punctate appearance of the leaves to which reference has already been made (p. 344). The glands themselves (Pl. XXXV. fig. 24) show a circular head, sometimes divided by one or two cross-walls into two or four smaller cells, containing dense granular protoplasm.

In vertical section (Pl. XXXV. fig. 25) the glands are almost identical in appearance with the hydathodes of *Piper nigrum*, described and figured by Haberlandt ('Physiologische Pflanzenanatomie,' 2nd edition, p. 420) and which also occur in depressions in the leaves. They are divided into three parts, called by Haberlandt the head, the stalk, and the foot. According to Haberlandt, the protoplasmic head functions as a peculiar water-gland. The stalk represents the mechanical apparatus of the whole organ, as it is provided with a thick ring of cellulose, which keeps a passage for the water always open and of a uniform diameter. The foot, which connects the gland with the adjoining epidermal cells and with the underlying tissue, is usually thin-walled. We have been unable to discover, in any of the glands of *Craterostigma pumilum* which we have examined, the ring of cellulose which Haberlandt describes and which was distinctly visible in the stalk-cell of the hydathodes of *Piper nigrum*, in sections which were cut for the sake of comparison with *Craterostigma*.

Whether the gland acts as a plug, when the depression deepens as the leaf dries, cannot be determined with certainty, but it appears to be probable.

Many of the epidermal cells contain one, or sometimes two bodies, which are more or less club-shaped (this varying somewhat in shape and size) and resemble cystoliths. Each is attached to the outer wall of the cell by a short stalk, which is in some cases very

slender, in others relatively thick (Pl. XXXV. figs. 25 & 26). In sections stained with gentian violet and eosin these bodies take up the eosin.

A transverse section of one of the large vascular bundles near the base of the leaf consists of vertical rows of vessels separated by parenchymatous cells. In longitudinal sections these vessels are seen to be spiral. Below the xylem is the phloem with its parenchyma, the whole being surrounded by an endodermis and a pericycle. The latter is interrupted on either side in the region of the phloem. No trace of internal phloem could be found; the bundles are strictly collateral. The smaller vascular bundles are very peculiar (Pl. XXXV. fig. 27). Among the large number of leaf-sections which we have examined, only one showed ordinary spiral tracheides. Their place seems to be taken by thin-walled tracheides with numerous transverse shelf-like rings or spiral thickenings.

Transverse sections show that the bundles consist of one or more rows of about three or five tracheides. Above each row of tracheides is usually a single cell as large as or larger than the tracheides in diameter, but thin-walled and without transverse thickenings. Below the tracheides, in all but the very smallest veins, are a few elements of phloem. The whole is surrounded by cells arranged in a manner which suggests a sheath. Beyond them are the ordinary parenchymatous cells of the leaf.

In longitudinal section the transverse thickenings are seen to be so numerous that the tracheides appear to be cut up into segments, square, or even broader than they are long. Between the ordinary spiral tracheides or vessels of the larger veins and the peculiar square elements are transitional forms consisting of shelf-like spirals which are more or less broken up.

The *Stem* is either a short thick root-stock or a creeping rhizome. It consists of a central pith surrounded by a relatively thick mass of xylem and a not inconsiderable phloem. The cortex contains numerous very large and irregular intercellular spaces, which, except near the central stele and the path of the adventitious roots, are lined with the red granules. The cortical cells, like those of the root, contain numerous leucoplasts (Pl. XXXV. fig. 20). The bundles are open and collateral, and there is a slight cambium. Surrounding the phloem is a fairly well-marked endodermis. But the vascular cylinder of the stem is much broken up by the large number of adventitious roots which arise in it and make their way through the cortex to the exterior.

The Red Colouring-matter *.—Owing to the scarcity of the material, we have only been able to examine the colouring-matter microchemically and with the aid of polarized light.

The colouring-matters of plants have been investigated by various observers, among others by Courchet ("Recherches sur les Chromoleucites," Annales des Sciences Naturelles, série 7, p. 263). According to this author, all colouring-matters other than chlorophyll and a few of very rare occurrence may be divided into two main groups: I. the *cyanic series*, and II. the *xanthic series*.

* Reddish colouring-matters are not uncommon in roots, but they are frequently confined to the sap, or are in hue, abundance, solubility, and other ways very different from the case we are considering. The reader may consult, *e. g.*, Hildebrand, Ber. d. deutsch. bot. Gesellsch. 1883, Bd. i. p. xxvii, and Ascherson, *ibid.* p. 498.

I. The cyanic series has for its type the red substance occurring in solution, and includes the blue, violet, and "carmine red" colours derived from it. The colours in this series all become red with acids and blue with alkalies.

II. The type of the xanthic series is the solid yellow colouring-matter either contained in or derived from plastids (leucites), together with orange-yellow, orange-red, and brick-red solid pigments.

When treated with *concentrated* sulphuric acid, these bodies all become indigo-blue of varying degrees of brightness. With iodine they all take on a green colour. All of them are insoluble in water.

The pigments of the xanthic series may be further divided into two groups with reference to their behaviour towards other reagents :—

a. Yellow pigments (xanthin of some authors).—These, according to Courchet, are never crystalline, nor can crystals by any means be obtained artificially from their solutions. They are slightly soluble in chloroform, benzine, and ether, but most soluble in alcohol. Before becoming blue with concentrated sulphuric acid they pass through an intermediate green stage, which may be due to a mingling of the pigment which has become blue with that which is still yellow.

β. Orange-yellow and orange-red pigments may be amorphous, or in the form of crystallites or crystals. They are most soluble in ether, benzine, and chloroform, and less so in alcohol. With concentrated sulphuric acid they pass through a violet or violet-red phase, probably on account of the mixing of blue and red colouring-matter.

These differences may be tabulated in the following way :—

Yellow Pigments.	*Orange-yellow and orange-red.*
Non-crystalline.	Amorphous, crystallites, or crystals.
Slightly soluble in { chloroform. benzine. ether.	Most soluble in { chloroform. benzine. ether.
Most soluble in alcohol.	Less soluble in alcohol.
With concentrated sulphuric acid, first green, then blue.	With concentrated sulphuric acid, first violet or violet-red, then blue.

The colouring-matter of the flowers of *Aloë* is so peculiar in its reactions that it was placed by Courchet in a group by itself. It occurs in the form of chromoplasts (chromoleucites) consisting of a coloured stroma, which is apparently homogeneous and contains very distinct pigmentary granules. With concentrated sulphuric acid the colour changes into a greenish yellow, but there are slight differences in this reaction due to the original colour and to the physical condition (whether crystalline or amorphous) of the pigment. Alkalies cause the formation of orange-coloured drops. In ether and chloroform the colour is almost insoluble; in alcohol it is very soluble, and forms a solution which Courchet describes as "currant-red."

The reactions of the red colouring-matter in the root of *Craterostigma* in some respects resemble those of the pigments of the xanthic group, in others those of the colour in *Aloë*-flowers, while in others again they are peculiar.

For the sake of comparison we have examined microchemically the colouring-matters in various plants in which they are present in a solid form and which have not been mentioned by Courchet. Some of these give the reactions which, according to Zimmermann ('Botanical Microtechnique,' translated by Humphrey, 1893, p. 101), are characteristic of carotin, and which also agree with those of Courchet's xanthic series. Carotin, the name originally given to the yellow colouring-matter first obtained from the roots of the cultivated carrot, is now proved to be more widely distributed, and to occur not only in many plants but in some animals (*cf.* Zopf, "Zur Kenntniss der Färbungsursachen niederer Organismen," Beiträge zur Physiologie und Morphologie, 1892 and 1893). It is supposed by some authors to be identical with that which has received the following names, as well as many others—chlorophyll-yellow, xanthophyll, erythrophyll, chrysophyll, etc., and to which is due the colour of leaves in autumn. The characteristic reactions of carotin with iodine and with concentrated sulphuric acid are those which distinguish the xanthic series as a whole. With regard to its behaviour towards alcohol, ether, benzine, and carbon bisulphide it in some respects resembles the yellow pigments, and in others the orange-yellow and orange-red colours which form the two divisions of Courchet's xanthic series.

By way of control experiments, we have compared the various reactions of the colouring-matter in the root of *Craterostigma* with those of the carotin in the flowers of *Tropæolum majus*, Linn.

Among other plants of which we have examined the colouring-matter for the sake of comparison was *Chamædorea Sartorii*, Liebm., which has thick floral axes coloured bright orange-red. The colouring-matter occurs as red granules in certain of the plastids which have also a coloured stroma. It is chiefly confined to a broad band of cells near the periphery, while those lying more internally contain chloroplasts. The cells in the centre of the axis are colourless.

In many of its reactions the colour in *Chamædorea* resembles carotin, but in some it is like the colour in the roots of our plant. Though many of the reactions of the latter are peculiar, yet on the whole they show a marked resemblance to those of the colouring-matter in the flowers of *Aloë*. For the sake of comparison with Courchet's results for *Aloë* and with our own for *Craterostigma*, we have examined microchemically the colour-bodies in *Gasteria*, a genus closely allied to *Aloë*. The results of a comparison of the solid colouring-matters contained in the flowers of *Tropæolum majus*, the floral axis of *Chamædorea Sartorii*, and in the flowers of *Gasteria formosa*, Haw., with that in the root of *Craterostigma pumilum* are summarized in the accompanying Table (p. 352) and may now be discussed.

The reactions of the red colour of the roots of *Craterostigma* with iodine and with concentrated sulphuric acid separate it at once not only from carotin, but from the whole xanthic series. With iodine the colour is not dissolved, but turns dark brown. With concentrated sulphuric acid the colour also at first becomes brown and then dissolves, forming a yellowish-brown fluid, but leaving an insoluble residue consisting of colourless granules.

Perhaps the most curious reaction, and one which suggests those of the cyanic series,

is the behaviour of the red colour of our plant towards potash. The colour first becomes a reddish purple and then a dull purplish or inky blue, but the pigment does not dissolve. The contents of the cell also take on the same colour. With nitric acid the colour dissolves and forms a fluid which is coloured brownish pink. With acetic, chromic, and hydrochloric acids the colour remains unchanged. In alcohol the pigment is extremely soluble and forms a red solution with a yellowish-brown or pink-brown tint. The colour is also very soluble, and forms a red solution, in ether; but in benzol, carbon bisulphide, and chloroform it is only slightly soluble.

The results we obtained with *Gasteria* are essentially the same as those which Courchet got with *Aloë*.

The colouring-matter in *Chamædorea Sartorii* in many of its reactions resembles carotin, but in some of those in which it differs it behaves like the colour in *Craterostigma*. Both are extremely soluble in alcohol, whereas carotin is only slightly soluble. But in *Chamædorea* this solution is followed by the formation of a finely divided yellow precipitate. Both are very soluble in ether, and only slightly so in benzol and carbon bisulphide.

The reactions of the colour in *Craterostigma* all differ markedly from those of carotin; among these the different behaviour of the two bodies towards concentrated sulphuric acid and towards iodine are specially noteworthy. In no single reaction does the red colour behave exactly like carotin. On the whole, though some of the reactions differ considerably, it is much more like that of *Gasteria* (or *Aloë*) than any other with which we have compared it.

With concentrated sulphuric acid *Gasteria* becomes first orange, then greenish yellow, fading into pale yellow and quickly becoming colourless. The changes of colour are so various and so rapid that it is extremely difficult to distinguish one from another and to observe their sequence. With iodine the colour becomes a pale yellowish brown. These reactions seem to be essentially the same as those which occur when the red colour in *Craterostigma* is treated with the same reagents. The difference is of degree rather than of kind, and may be due to the fact that the original colour of *Gasteria* is pale pink and of *Craterostigma* a deep but bright red.

With alcohol both are very soluble and form pink or red solutions. Both are only partly and slowly soluble in benzol, carbon bisulphide, and chloroform, with which they form pink or red drops of fluid. They differ, however, in their solubility in ether. The red colour dissolves readily, the pigment in *Gasteria* is almost insoluble. Potash, which with carotin and the colour in *Chamædorea* gives no reaction, affects, but in different ways, both the colour in *Craterostigma* and in *Gasteria*. That in the former rapidly becomes reddish purple, then a dull blue, while that in the latter slowly changes to a yellowish brown.

Hydrochloric acid with the red colour in our plant gives no reaction, but it changes that in *Gasteria* into orange, which becomes yellow and then fades away.

With nitric acid the red colour dissolves and forms a brown-pink solution, while that in *Gasteria* behaves essentially like carotin and the colour in *Chamædorea*; the colour first becomes yellowish, and then rapidly disappears. Carotin takes on a blue, and the

Reagent.	Colour-Bodies in			
	Tropæolum majus.	*Chamædorea Sartorii.*	*Gasteria formosa.*	*Craterostigma pumilum.*
Iodine	Greenish or greenish-blue.	Blue-green.	Yellow-brown.	Brown.
Concentrated sulphuric acid	Violet, then indigo-blue.	Blue.	Orange, greenish-yellow, pale yellow, fading to colourless.	Brown; then dissolves, and yellow-brown fluid is formed. Insoluble residue.
Water	Insoluble.	Insoluble.	Insoluble.	Insoluble.
Alcohol	Almost insoluble.	Soluble; yellow fluid formed, then yellow precipitate.	Very soluble; pink solution.	Soluble, forming red fluid.
Ether	Slightly soluble.	Very soluble; yellow drops of fluid formed.	Slowly soluble; orange drops.	Very soluble, forming a red solution.
Benzol	More soluble.	Partly and slowly soluble.	Slowly soluble; orange-pink drops formed.	Partly and slowly soluble; red solution formed.
Carbon bisulphide	Easily soluble.	Insoluble.	Slowly soluble; pink drops.	Partly soluble; red drops formed; colourless granules left.
Chloroform	Easily soluble.	Soluble; bright reddish-yellow solution.	Slowly soluble; orange-pink drops.	Slowly soluble; bright reddish-brown fluid.
Potash, 5 °/₀ solution	Insoluble.	Insoluble.	Slow change to yellow-brown.	Reddish purple, then dull inky purple.
Acetic acid, 1 °/₀ solution	Insoluble.	Insoluble.	Insoluble.	Insoluble.
Chromic acid, 1 °/₀ solution	Insoluble.	Insoluble.	....	Insoluble.
Hydrochloric acid	Insoluble.	Bluish-green.	Orange; yellow, fading into very pale yellow.	No visible reaction.
Nitric acid	Blue, immediately becoming colourless.	Blue-green, rapidly fading into yellow and becoming colourless.	Yellowish, rapidly becoming colourless or almost colourless.	Soluble; brown-pink solution.

colour in *Chamædorea* a blue-green colour before becoming yellow, and, according to Courchet, that in *Aloë* also first becomes green. This reaction is a very remarkable one to watch, as the change is so rapid that, as the reagent penetrates the tissues, a wave of colour passes over the field, changing and disappearing as soon as it is formed.

Optical Properties of the Pigment.

The granules were examined by means of polarized light, both in the fresh plant and in the residue which remained after evaporation of the alcoholic extract. The granules thus obtained differed little, if at all, from those in the fresh root. Owing to their extremely small size, nothing definite could be determined about them, but they appeared not to be crystalline *.

We do not think that the colouring-matter occurs in drops in the plant, because the solid granules which are obtained from the alcoholic extract seem to be identical with those in the fresh tissues.

We have also applied the tests for tannin, but with negative results.

We therefore regard the evidence as being against the possibility of the colouring-matter being an oily or resinous body in drops, and it is certainly against its being a crystalline substance allied to carotin. It appears to be present in the form of rounded non-crystalline granules which may possibly be resinous, and which in their micro-chemical reactions most closely resemble the colouring-matter in the flowers of *Aloë*.

When the plant is placed with its roots in water and exposed to the action of light, the red colour, even after an interval of some weeks, changes very little. And this apparent fading may be due to the change of the leucoplasts into chloroplasts, and the consequent influence on the colour of the root as a whole; in solution, however, the colour slowly fades in the light.

The place of origin of the pigment may now be considered. Courchet has shown that solid pigments are usually, if not always, formed by plastids; and this fact, taken in connexion with the presence of such plastids in the tissues which contain the colour, points to the origin of the pigment in these bodies, although we have never seen any of the colouring-matter within the cells of our plant.

Any suggestion that the granules may be bodies foreign to the plant, and of the nature of bacteria, is rendered impossible on account of their complete solubility in more than one reagent, and also because they occur in spaces which are usually closed and have therefore no connexion with the exterior.

The excretion of colouring-matter by both plants and animals is not an uncommon phenomenon. Such cases of the excretion of carotin are recorded by Zopf. Zimmermann (' Botanical Microtechnique,' English edition, p. 112) mentions the excretion of colouring-matter (which may be crystalline or, more rarely, amorphous) by various lichens.

As to the possible uses of the pigment we can offer no definite suggestions. It may

* The colouring-matter of *Aloë*, which resembles that in our plant, also occurs in distinct granules which are non-crystalline, and it has not yet been obtained in a crystalline form.

be that the colour is merely incidental, and that it is the granules themselves which are of use to the plant.

In discussing the uses of carotin to the plants in which he found it, Zopf suggests three possible functions for the colour :—

(1) That it is a protection against light;

(2) That it protects the plant against the attacks of plant-eating animals;

(3) That it is a reserve material.

The first hypothesis is untenable in the case of our plant, because the colour occurs in those parts of the plants which are not exposed to the light.

The second suggestion was abandoned by Zopf because, in the case of carrots, carotin is no protection from the attacks of snails and other animals.

The third suggestion seems to us to be extremely improbable, especially as the colouring-matter is produced in such large quantities in the intercellular spaces in perfectly active organs. And, as we find no evidence of resorption, it may be taken to be an excretion.

It may be that some of the peculiarities of the colouring-matter in our plant are due to its environment *. In this connexion Zopf's work on *Trentepohlia Iolithus*, Wallr., an alga growing on bare rocks, is interesting and suggestive. In this plant, which is alternately dried up by sun and wind and brought into a resting condition, and supplied with water by rain and dew and so enabled to grow, the reserve materials take the form of oil-drops and of included crystals of carotin, *i. e.* of bodies which are insoluble in water.

It may be that a reserve material which is insoluble in water would be more stable and less liable to be influenced by metabolic changes dependent upon fluctuations in the amount of water present in the plant, especially if, as is the case in *Craterostigma*, it is placed outside the cells.

But it is difficult on any hypothesis but that of excretion to account for the position of the granules outside the cells.

EXPLANATION OF THE PLATES.

Plate XXXIV.

Fig. 1. Whole plant, about natural size, showing leaf-rosette and red roots springing from the short root-stock (also red), one fully-expanded flower and two from which the corolla has fallen.

Fig. 2. A stolon with three buds, somewhat enlarged.

Fig. 3. Cross section of a bud, slightly magnified, showing sub-opposite leaves.

Fig. 4. Flower-bud viewed (*a*) from the side, (*b*) from below—anterior view, (*c*) from above—posterior view.

Fig. 5. Corolla seen from (*a*) the side, (*b*) above, and (*c*) below.

* We believe that our plant comes from a rocky region, where it would be exposed to periodic droughts.

Fig. 6. A flower from which the corolla has fallen, showing persistent calyx and style.

Fig. 7. Vertical section of ovary in the antero-posterior plane, showing superior position, large axile placenta, and terminal style. At (*b*) a lateral, and (*c*) front view of lipped stigma.

Fig. 8. Corolla dissected open from above and the posterior lobe removed: natural size.

Fig. 9. Corolla laid open from below, magnified.

Fig. 10. Transverse section of ovary and calyx, magnified.

Fig. 11. A young capsule, projecting beyond the persistent calyx.

Fig. 12. Ripe capsule opening by two valves, septicidal and septifragal.

Fig. 13. Ripe seed, showing the pitting.

Fig. 14. Longitudinal median section of seed, showing nearly straight embryo in axis of endosperm.

Plate XXXV.

Fig. 15. Transverse section of root, showing central stele, and cortex with the large regular intercellular spaces filled with the red pigment. The two outer layers have neither spaces nor pigment. Low power.

Fig. 16. Portion of above, more highly magnified (Zeiss D), showing pigment lining walls of spaces.

Fig. 17. Transverse section of stele of root, with six xylem-strands, endodermis, pericycle, &c., of normal type.

Fig. 18. Radial longitudinal section of outer root-cortex and piliferous layer, showing intercellular spaces and pigment—*cf.* fig. 19—and the peculiarly thickened outer cell-walls of some of the cells of the piliferous layer.

Fig. 19. Tangential oblique section of cortex of root, showing peculiar appearance caused by the arrangement of the intercellular spaces.

Fig. 20. Transverse section of the rhizome, showing central stele, origin of roots, and oblique sections of vascular strands to the leaves. The intercellular spaces of the outer cortex are filled with the red pigment, except just below the epidermis.

Fig. 21. Part of transverse section through lamina of leaf, showing differences between upper and lower epidermis, and the feebly differentiated palisade-tissue. Stomata and glands occur both above and below.

Fig. 22. Transverse section through base of leaf, showing the pigmented intercellular spaces in lower portion only.

Fig. 23. A stoma in vertical section.

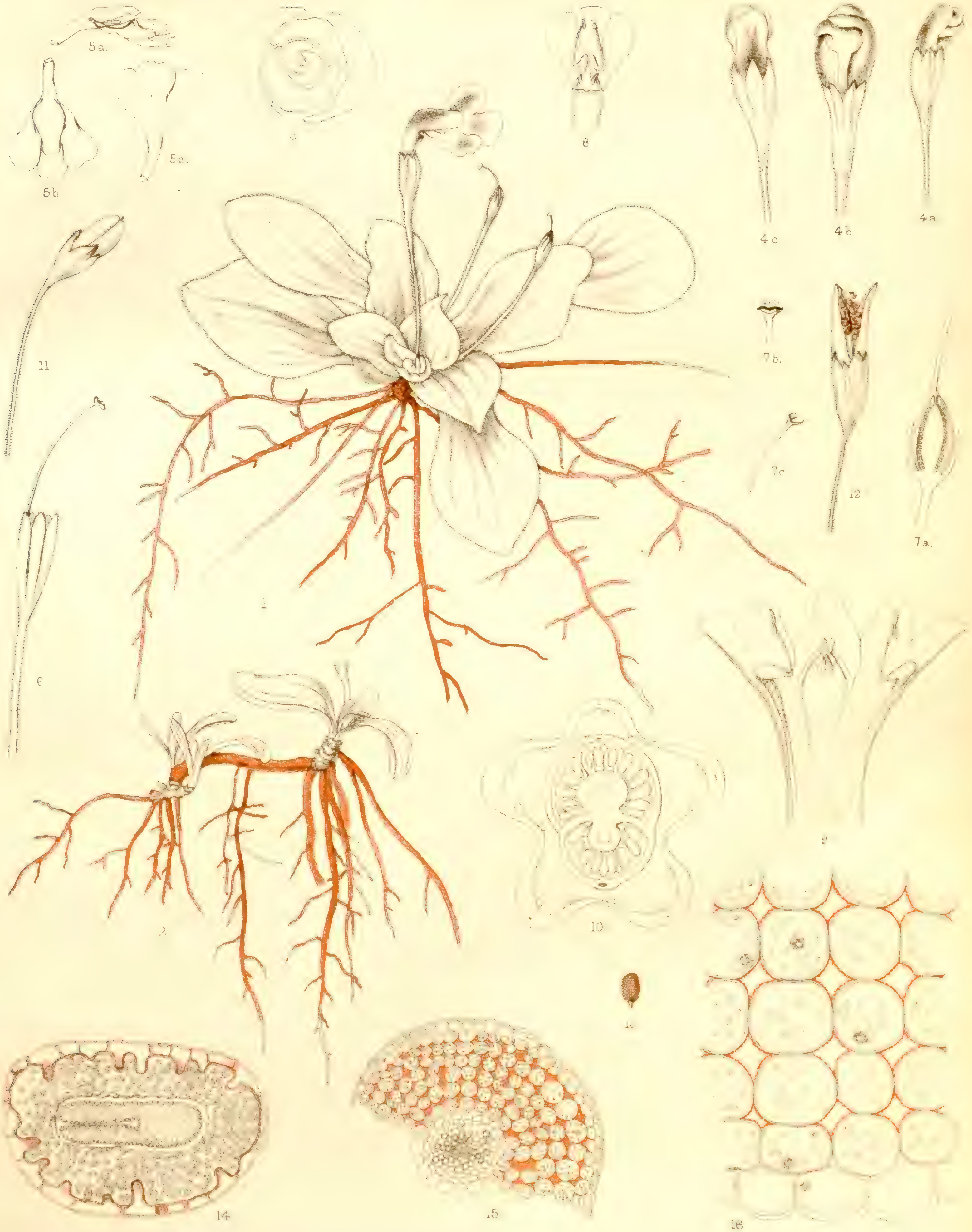
Fig. 24. Two of the glands, seen from above.

Fig. 25. A gland and its pit in vertical section: in one of the epidermal cells a cystolith-like body.

Fig. 26. Section of epidermis, showing two cystoliths.

Fig. 27. Section across a small vein of leaf.

Fig. 28. Longitudinal section of small vein of leaf, showing the peculiar short tracheidal elements with shelf-like thickenings.



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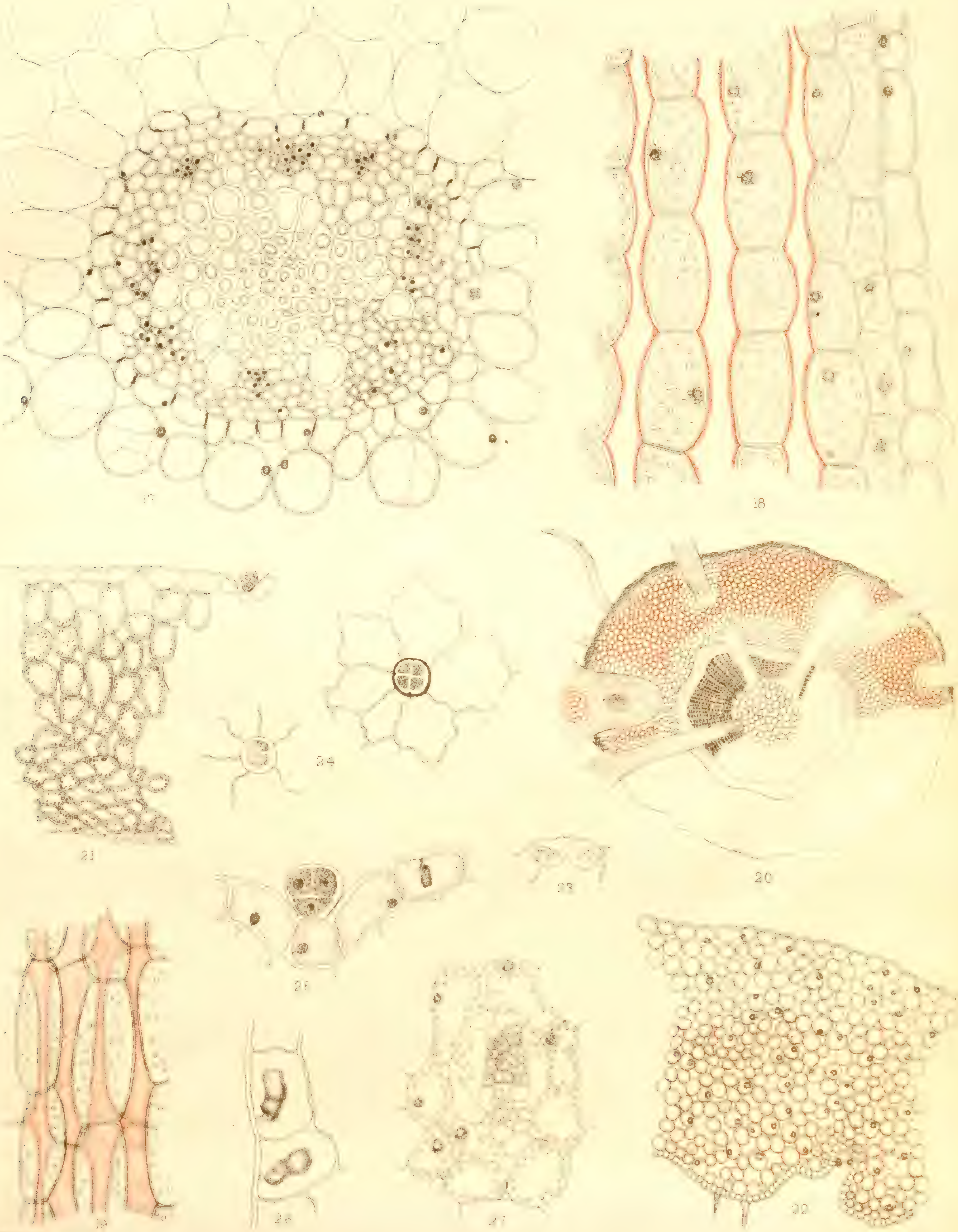

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THE STRUCTURE OF LEPIDOSTROBUS.

BY

ARTHUR JOHN MASLEN.

(*Communicated by* D. H. SCOTT, Ph.D., M.A., F.R.S., F.L.S.)

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XI. *The Structure of* Lepidostrobus. *By* ARTHUR JOHN MASLEN. (*Communicated by* D. H. SCOTT, *Ph.D., M.A., F.R.S., F.L.S.*)

(Plates XXXVI.-XXXVIII.)

Read 19th January, 1899.

INTRODUCTION.

THE large collection of sections of fossil plants formed by the late Prof. W. C. Williamson, F.R.S., and now preserved in the Natural History Museum, contains a considerable number of slides which he referred to *Lepidostrobus*.

Owing to the fragmentary character of the remains, it has been found impossible to refer with certainty any of these *Lepidostrobus* slides, in which the structure is preserved, to the particular vegetative organs to which they belong; although, from the association of vegetative stems and strobili in the same deposit, Williamson was led to believe that we know the strobilus borne by *Lepidodendron brevifolium*, Will.* (the Burntisland form), and probably also that of the Arran type, *Lepidodendron Wunschianum*, Will.†

In 1877 ‡ Williamson first described as a *Lepidostrobus* a cone of marked individuality to which, later (in 1879) §, he gave the name of *Lepidostrobus insignis*. Still later (in 1889) ‖ he described a supposed vegetative stem to which he gave the name of *Lepidodendron Spenceri*, and in his last memoir "On the Organization of the Fossil Plants of the Coal Measures," read in 1892 ¶, the connection between this supposed vegetative stem and the previously described strobilus was established. The researches of Dr. Scott have shown, however, that *Lepidodendron Spenceri*, Will., is but the *peduncle* of the strobilus, and peculiarities of the latter have led this author to remove it from the *Lepidostrobi* altogether, and to refer it to a new genus—that of *Spencerites* **. In this case also, therefore, the true vegetative organs are either unknown or unidentified.

* Williamson, W. C., "Organization of the Fossil Plants of the Coal Measures, Part III.," Phil. Trans. 1872, p. 296; "General, Morphological, and Histological Index to the Author's Collective Memoirs on the Fossil Plants of the Coal Measures," Part II. p. 102, Mem. & Proc. Manch. Lit. & Phil. Soc. series IV. vol. vii.

† "General Index," Part II. p. 109.

‡ Williamson, "Organization," Part IX., Phil. Trans. 1878.

§ *Ibid.*, Part. X., Phil. Trans. 1880, p. 502.

‖ *Ibid.*, Part XVI., Phil. Trans. 1889, p. 199.

¶ *Ibid.*, Part XIX., Phil. Trans. 1893, p. 24.

** Scott, D. H. "On the Structure and Affinities of Fossil Plants from the Palæozoic Rocks. II. On *Spencerites*, a new Genus of Lycopodiaceous Cones from the Coal Measures, founded on the *Lepidodendron Spenceri* of Williamson," Phil. Trans. B. 1898.

But not only is it generally impossible to refer isolated strobili to the corresponding vegetative organs, but it is almost as difficult to refer isolated sections of the same type of strobilus, with certainty, one to another. In 1892, Williamson, in the memoir before referred to, called attention to this. He there tells us:—"I have for many years endeavoured to discover some specific character by which different *Lepidostrobi* could be distinguished and identified, but thus far my efforts have been unsuccessful . . . I have, however, figured in Plates 8 and 9 some of the more distinctive modifications that I have observed" *. After briefly describing a number of apparently distinct forms, including a series of sections of what is, apparently, a homosporous form from Oldham (memoir xix. figs. 58, 59, 60, 61, 62, C.N. † 568, 574), and pointing out that Mr. Binney, in his memoir on *Lepidostrobus* ‡, had described sections cut from the same specimen under the name of *Lepidodendron Harcourtii*, Williamson says:—"I continue to shrink from giving specific names to examples which, in all probability, only represent types of forms reappearing in more than one species; but, as in a previous memoir, I still recognize the opposite inconvenience of having no concise means of referring to any object figured. With a distinct understanding as to the meaning and purpose of such names, and since the *Lepidostrobus* under consideration is rather characteristic of the Oldham deposits, I will designate the type *L. oldhamius*" §.

Williamson gave a brief description of this type, necessarily incomplete owing to the fact that he had no longitudinal section passing through the axis of the cone, although such a section is contained in the Binney Collection at Cambridge, and was figured in Binney's memoir ‖.

At the beginning of this year I undertook, at Dr. Scott's suggestion, a re-examination of the Williamson slides of *Lepidostrobus* with the object of discovering whether it was not possible to make out at least some distinct forms.

The collection contains two sections of a cone of considerable size (C.N. 1776 A, 1776 B) collected by Mr. G. Wild, and exhibiting some of the structures in a very beautiful manner. It is probably a comparatively recent addition to the collection, and Mr. Wild informs me that he found it in the Lower Coal Measures, near Stalybridge. One of the sections (C.N. 1776 A) has an extreme length of nearly 8 centims.; it passes through the cone in an oblique longitudinal direction, passing below into the xylem of the axis and exhibiting the sporophylls and sporangia in approximately radial section, while above it becomes more tangential. Figures drawn from this slide are shown on Pl. XXXVIII. figs. 24-30 and 32-34. The other section from the same specimen is more tangential and only shows numerous sections of sporophylls supporting sporangia, similar to those shown on Pl. XXXVIII. fig. 30. The extreme length of this section

* "Organization," &c., Part XIX. (1893) p. 26.

† Slides in the Williamson Collection have the letters C.N. (Cabinet Number) before the number in the series; those belonging to Dr. Scott are preceded by the letter S.

‡ "Observations on the Structure of Fossil Plants found in the Carboniferous Strata, Part II. *Lepidostrobus* and some allied cones." Palæontographical Society, 1871, pl. 7, p. 46

§ "Organization," &c., Part XIX. p. 28.

‖ *Loc. cit.* pl. 7. fig. 3.

is about 9·5 centims. A third section (C.N. 1776 C), obtained from the Bullion Bed at Oldham, agrees so exactly with C.N. 1776 A and 1776 B as to leave no question as to its being the same form.

Comparison of these three slides (C.N. 1776 A, 1776 B, 1776 C), which I may for convenience designate "Wild's Cone," with the type slides of *Lepidostrobus oldhamius*, Will. (C.N. 568, 574), shows that, so far as the corresponding structures can be compared in the absence of a transverse section of Wild's Cone, they are identical. It seems possible therefore, with the aid of these beautifully preserved longitudinal sections, to work out the structure of the cone in this type in greater detail than has hitherto been done.

In Williamson's "Organization," &c., Part XIX. 1893, fig. 57, is figured a *Lepidostrobus* which seems to merit more notice than that accorded in the text: "Fig. 57 is a fine longitudinal section of a *Lepidostrobus* (× 4, C.N. 1614) with radially elongated sporangia and sporangiophores. It is homosporous" (p. 27). Although the sections in the Williamson Collection, with others lent by Dr. Scott, do not enable me to give anything like a complete account of the strobilus, yet they are sufficient to show that it is a distinct form, and for this type I propose the name of LEPIDOSTROBUS FOLIACEUS, on account of the leaf-like character of the sporophyll-laminæ.

Most of the other slides in the Williamson Collection appear to agree more closely with the original sections described by Williamson as *Lepidostrobus oldhamius*, and under this type name I shall describe some of them in this paper. There are, however, minor differences in structure in the different sections, some of which, when more or better material comes to be examined, may ultimately prove to be of specific value. At present the difficulty (in dealing with isolated sections such as these) of making certain whether the differences are really of specific value, or are only variations dependent on the age, the degree of development, or the part of the cone from which the section was cut, is very great. It seems safer therefore, at present, to adopt the name *L. oldhamius* for a type of structure of which some of the most marked variations will be described in the following paper as *L. oldhamius* (α), (β), and (γ).

Before proceeding to the detailed consideration of the slides specially to be considered in this communication, a *résumé* may be given of our knowledge of *Lepidostrobus*, particularly of the *L. oldhamius* of Williamson. The generic characters given by M. Zeiller * may be accepted as the modern conception of the genus. The following literal translation I take from Dr. Scott's memoir on *Spencerites* †, the italics being M. Zeiller's own:—"*Cones of fructification* cylindrical, oblong, or ovoid; composed of a woody axis bearing sporangiferous bracts arranged in a spiral, and somewhat crowded. *Bracts formed of a narrow pedicel*, usually normal to the axis, *and of a uninervate limb, lanceolate or linear-lanceolate in outline*, generally erect, and often even applied to the surface of the cone. Sporangia ovoid, solitary, fixed upon the superior face of the pedicel of the bracts."

* 'Bassin Houiller de Valenciennes. Description de la Flore Fossile,' 1888, p. 496.

† Phil. Trans. B. 1898, p. 99.

Referring to Williamson's figures of *Lepidostrobus oldhamius* *, pl. ix. fig. 58 (C.N. 568) is a transverse section, showing at the centre the relatively small vascular cylinder surrounding a pith; then a space representing the inner and middle cortex, in which can be seen transverse sections of the sporophyll bundles; and at the periphery of the axis the dark, somewhat disarranged outer cortex, passing into the radially disposed sporophylls *d*, bearing the large, bulky sporangia. On Pl. XXXVII. fig. 23 of the present paper is shown a photograph of the central structures from the same slide as that figured by Williamson. At *m.* are the remains of the pith-cells, the pith here being relatively small as compared either with *Lepidostrobus Brownii*, Schimp. †, or the (*a*) form of *L. oldhamius* to be hereafter described; *x.* is the xylem cylinder, passing at the periphery into a zone of smaller elements, the latter projecting into points as in *Lepidodendron Harcourtii*, Witham, and other forms; *l.t'.* are leaf-trace (sporophyll) bundles just free from the xylem cylinder and now seen traversing a space from which the softer tissues have disappeared; *i.c.* the inner cortex with bundles passing through it, and *l.t.* leaf-trace bundles contained in a space representing the middle cortex. Here each bundle was evidently collateral in structure, the xylem being at x', a space representing the phloem at p', while a parenchymatous sheath is seen surrounding the whole bundle.

Returning again to Williamson's figures, pl. 1. fig. 59, another transverse section of the axial structures, shows that while the sporophyll bundle is passing through the dark outer cortex, there is a second empty space *external* to the parenchymatous sheath before mentioned. The origin of this space cannot be made out from the sections figured by Williamson, but in a longitudinal section (C.N. 1613, see my Pl. XXXVI. fig. 10), to be afterwards described, it is seen to arise below the bundle and to be continuous with the middle cortex space. It doubtless corresponds with what has been described as the parichnos in the vegetative leaves.

In the vertical section of the same cone, also figured by Williamson (pl. 6. fig. 61, C.N. 574), on the left the cone is cut more or less tangentially, exhibiting the pedicels of the sporophylls *b* in transverse section, each supporting a sporangium *a*. On the right the section traverses the cone in an obliquely radial direction and shows that the sporophyll passes outward in an approximately horizontal direction, forming at the periphery of the cone the somewhat peltate extremity b'. The ligule can also be quite well seen in the slide from which this drawing was made (C.N. 574), although it was not described or figured by Williamson ‡.

As Prof. Williamson has pointed out:—"Mr. Binney described and figured the above species twice over: once from the specimens from which my sections were also derived, when he assigned to it the name of *Lepidodendron Harcourtii*; and again in plate viii., when he gave to it the name of *L. vasculare*. I am obliged to reject both these specific determinations" §.

* "Organization," &c., Part XIX.

† Bower, "On the Structure of the Axis of *Lepidostrobus Brownii*, Schpr.," Ann. Bot. vol. vii. pl. 16. fig. 1.

‡ Maslen, "The Ligule in *Lepidostrobus*," Ann. Bot. vol. xii. p. 258.

§ "Organization," Part XIX. p. 28; Binney, in Palæontogr. Soc. 1871, pls. 7 & 8.

I will now pass to the sections forming the principal subject matter of this communication, beginning with *Lepidostrobus oldhamius* as being the most completely known form.

LEPIDOSTROBUS OLDHAMIUS, Will. (α).

This form is based on four slides, three of which (C.N. 572, 1613, 1613 *d*) are contained in the Williamson Collection, and the fourth (S. 85) in that of Dr. Scott, F.R.S. The sections are all isolated, *i. e.* there is no evidence as to whether they all belong to different specimens or not. The longitudinal sections are only fragments, and include neither the base nor apex of the cone, so that it is impossible to give any idea as to its length, &c. The diameter of the transverse sections is between 2 and 3 centims. The central axis of the cone has a diameter varying in the two transverse sections between about 3·5 millims. (S. 85) and 4·0 millims. (C.N. 1613 *d*); that of the central vascular cylinder being ·7 millim. (S. 85) and ·75 millim. (C.N. 1613 *d*) respectively.

These slides are specially valuable for the perfect preservation of some of the axial structures, the sporophylls and sporangia being only imperfectly shown: Wild's Cone, on the contrary, exhibits well the structure of the appendages, and it is hoped that by a combination of the two forms the structure of *Lepidostrobus* may be made out in a fairly complete manner, although it must be admitted that there are still considerable lacunæ in our knowledge which can only be obliterated by the discovery of yet more perfect remains.

The general arrangement of parts is quite similar to that of *L. oldhamius* as described by Williamson (the β form in the present paper), as will be seen by comparing his figures before quoted with those in Plates XXXVI. and XXXVII.

Pl. XXXVI. fig. 1 is a partial transverse section of the cone, showing at *m* the pith-cavity surrounded by the vascular cylinder *x*. The stele evidently contained a relatively large medulla (larger than in the β form), although, unfortunately, in neither of the transverse sections are any of the pith-cells preserved; while the longitudinal section (C.N. 1613), in which the anatomical structure is best seen, is not sufficiently radial to pass through the medulla.

Outside the wood is an empty space, *i.s.*, from which the softer tissues (probably phloem and pericycle) have perished. Leaf-trace bundles are seen passing through this space. Beyond this, the usual three zones of the cortex can be recognized: *i.c.*, the inner cortex, with leaf-trace bundles passing through it; *m.c.*, the middle cortical space, with transverse sections of the leaf-traces *l.t.*, each surrounded by a parenchymatous sheath; and *o.c.*, the outer cortex. Around the axis are shown sections of sporophylls *sph.*, and remains of sporangia with spores, *sm.*

The Vascular Cylinder, &c.—As in *L. oldhamius* (β), the smaller xylem elements constitute a peripheral zone with which the xylem of the leaf-traces is continuous. Comparison of Pl. XXXVI. fig. 2 with the similar section of *L. oldhamius* (β) shown on Pl. XXXVII. fig. 23 exhibits at once a difference in the number of the larger xylem elements in the radial direction. In the former the average number of such elements is but 2 or 3, sometimes reduced to 1; whereas in the latter they number 4–6.

Another peculiarity in the vascular cylinder of this type is seen in the abundance of short tracheides ("barred cells") in the peripheral region. Pl. XXXVI. fig. 2 is a transverse section showing the vascular cylinder, inner cortex, and emerging leaf-trace bundles, some of the short tracheides being shown at *s.t.* Pl. XXXVI. fig. 3 is a longitudinal section of the xylem cylinder; it is not, however, truly radial, and so does not pass through the pith. The larger tracheides *x.* exhibit scalariform thickening, and are quite similar to those shown on Pl. XXXVIII. fig. 24 from *Lepidostrobus oldhamius* (β). At the periphery can be seen some of the characteristic short tracheides. Two of these short tracheides from the same section (C.N. 1613) are shown more highly magnified on Pl. XXXVI. fig. 4.

Some of the smaller peripheral xylem elements appear to show spiral thickening, and doubtless here, as in other *Lepidodendra*, the development was centripetal, the protoxylem occupying the periphery of the wood.

At first thought it might appear that in the presence of these short tracheides we have something similar to the arrangement seen in the axis of *Lepidodendron selaginoides*, and so characteristic a feature of that type of stem *. There is, however, the striking difference that, whereas in *L. selaginoides* the barred cells are found intermingled with ordinary parenchymatous cells about the *centre* of the stele, in *Lepidostrobus oldhamius* (α) these short tracheides are found only at the *periphery* of the xylem, among the smaller elements which give rise to the leaf-trace bundles, so that there is no real resemblance between the two forms, excepting in so far as they both possess similar short barred elements.

Another feature which is beautifully preserved in this form is the presence of a comparatively thick zone of parenchymatous tissue completely investing the xylem cylinder. This tissue is best seen in the longitudinal sections (see Pl. XXXVI. figs. 3 & 5). In both these figures it will be seen that the tissue in question, *p.*, consists of fairly thin-walled, generally flat-ended cells, showing an arrangement in vertical series. The cells are but little elongated in the longitudinal direction, and the vertical sections show no trace of anything here besides ordinary parenchyma; there is no indication of sieve-tubes or special phloem elements of any kind. Moreover, there is some evidence that these cells passed at the periphery into a more delicate tissue with longer cells (see Pl. XXXVI. fig. 3), but the latter tissue has almost entirely disappeared from around the central axis of the cone.

As will be shown later, there is abundant evidence in the leaf-trace (sporophyll) bundles of the presence of a tissue between the xylem and phloem, which is here fairly well preserved; and there can be little doubt that around the central axis the true phloem is represented by a portion of the empty space within the inner cortical zone, and that there was a distinct parenchymatous tissue between the xylem and phloem.

The same tissue can also be seen in the transverse sections (see Pl. XXXVI. fig. 2, *p.*).

Through this tissue the leaf-trace bundles pass, diverging only very gradually from the xylem cylinder, as shown on Pl. XXXVI. fig. 5, *l.t'.*, in longitudinal, and Pl. XXXVI. fig. 2, *l.t.*, in transverse section. See also the diagram, Pl. XXXVII. fig. 22.

Cortex.—As Prof. Bower has shown†, there is in *Lepidodendron* a differentiation of

* See figures in Williamson, "Organization," Part II., Phil. Trans. 1872, and Part XI., Phil. Trans. 1881.

† Ann. Bot. vol. vii. p. 343.

the primary cortex into three more or less distinct zones, of which the middle zone was of a softer and often of a very spongy or even of a trabecular character. The same is true also of *Lepidostrobus*, in which only the primary tissues are developed.

Beyond the inner space (Pl. XXXVI. fig. 2, *i.s.*), the inner cortex, *i.c.*, is well shown. It is thin (narrow radially), varying from 2–6 rows of cells in radial thickness, the maximum given here being about equal to that of *L. oldhamius* (β) (see Pl. XXXVII. fig. 23, *i.c.*). In vertical section (Pl. XXXVI. fig. 5, *i.c.*) the cells are seen to be somewhat elongated in the vertical direction and to have, generally, oblique cross-walls. The cells are also seen to be larger than those of the tissue immediately investing the axis. The transverse section (Pl. XXXVI. fig. 2) shows the way in which the leaf-trace bundles pass through the inner cortex, and how they obtain from it a sheath which, as we shall see, accompanies them into the sporophylls.

Outside the inner cortex is the wide space (Pl. XXXVI. fig. 1, *m.c.*, and fig. 2, *m.c.*) representing the middle cortex. No trace of the tissue formerly occupying this space can be seen in any of the sections, either at its inner or outer limit or around the leaf-trace bundles by which it is traversed, a fact to be explained only on the assumption that the tissue was of an exceedingly delicate nature.

The outer cortex is well preserved and has a thickness (between the points of insertion of the sporophylls) of about ·5 millim. The cells are thick-walled, and many show the peculiar structure represented in tangential section on Pl. XXXVII. fig. 15, *o.c.*; in radial section on Pl. XXXVI. fig. 7, *o.c.*, and fig. 8; and in transverse section on Pl. XXXVI. fig. 9. As already pointed out, these cells are thick-walled, and they show in their interior what appears to be a shrunken lenticular mass probably representing the remains of some peculiar contents, or possibly only a swollen inner layer of the cell-wall.

These peculiar cells appear to be highly characteristic of this form of *Lepidostrobus*, and can be seen not only in the outer cortex of the axis, but also in the cells which form the cortex of the sporophylls (see Pl. XXXVI. fig. 7). Sections of the latter, even when forming the free scales (laminæ) at the periphery of the cone, still exhibit a peripheral zone of cells possessing much the same structure (Pl. XXXVII. fig. 17). Cells of this character, though highly characteristic of the form under consideration, are still not confined to it; some cells presenting similar characters can be seen in sections of other forms. In the longitudinal section of Wild's Cone (*L. oldhamius* (β), C.N. 1776 A, see Pl. XXXVIII. fig. 26, showing the cells of the outer cortex in longitudinal section), in which the structure of the outer cortex is perfectly preserved, no trace of such cells can be seen, though similar cells can be seen around the periphery of the sporophylls in the same section. Moreover, in *L. oldhamius* (α) the outer cortical cells are on an average much rounder and shorter than those of *L. oldhamius* (β), (*cp.* Pl. XXXVI. fig. 8 and Pl. XXXVIII. fig. 26), making it almost certain that the differences are not merely due to peculiarities in mineralization.

The Leaf-trace Bundles.—The leaf-trace bundles arise, as is usual in the *Lepidodendra*, from the peripheral portion of the vascular cylinder, and pass very gradually obliquely outwards until they reach the outer cortex, where they bend outward more rapidly to the sporophylls.

The tracheæ in each bundle vary in number between about 10 and 16, and the smaller elements certainly in many cases appear to occupy an internal position, so that we have here, probably, another example of the mesarch type of vascular bundle (see Pl. XXXVI. fig. 12) commonly found in the foliar bundles of recent Lycopods * and Cycads, as well as in many of the old Palæozoic Cryptogams †.

When passing through the inner space (Pl. XXXVI. fig. 2, *i.s.*) the bundles, *l.t.*, show an investment of fine parenchymatous cells extending completely round them. On Pl. XXXVI. fig. 5, at *l.t''.*, is shown a similar bundle in the inner space, and here, too, it is seen to have a parenchymatous investment of cells even where quite free from the central parenchyma. The bundle shown on Pl. XXXVI. fig. 2, *a*, at the inner margin of the inner cortex, still retains an almost complete investment of these thin-walled cells. So there seems no doubt that the outgoing leaf-trace bundles are accompanied by an investment of parenchymatous cells, and that these cells are continuous with those immediately surrounding the xylem cylinder of the axis of the cone.

Leaving the inner space, the bundle next traverses the inner cortex. The transverse section (Pl. XXXVI. fig. 2) shows how the bundle, enveloped in its investment of cells, gradually passes outward towards the inner cortex, which gradually bulges out into a bay into which the bundle enters. It is here that we first have evidence of the collateral structure of the bundle, the space on the outer side of the xylem and between it and the inner cortex doubtless representing the position formerly occupied by the phloem. As the bundle passes through it, the cells of the inner cortex gradually close up behind and the bundle carries away with it a complete sheath of cells. This is also shown in longitudinal section on Pl. XXXVI. fig. 5, where, at *l.t'''.*, a leaf-trace bundle is shown in connection with the inner cortex, *i.c.*

It appears, then, that each bundle is provided with two sheaths—one surrounding the xylem only and continuous with the tissue immediately investing the central xylem cylinder; the other, surrounding both xylem and phloem, consisting of somewhat thicker-walled and larger cells continuous with the inner cortex. In the single bundle from the middle cortical zone shown on Pl. XXXVI. fig. 12, these two sheaths are shown at *p.* and *i.c.sh.*

In the middle cortex-space the bundles have a diameter (including the inner cortex-sheath) of about ·15 millim. (C.N. 1613, 1613 *d*, S. 85), and the sections show (see Pl. XXXVI. fig. 12) that the cells of the inner cortical sheath, *i.c.sh.*, are larger at the inner side of the bundle, and that they gradually become smaller towards the outer side of the trace. Pl. XXXVI. fig. 11 is a longitudinal section through a bundle in this region. The larger cells of the inner cortical sheath are shown at the inner side of the bundle at *i.c.sh.*, and the smaller somewhat more elongated ones at the outer side at *i.c.sh.'*; *x.* is the xylem, exhibiting the usual scalariform thickening, and *p'.* the phloem, here preserved. The latter consists of exceedingly thin-walled elements, elongated in the vertical direction

* I am indebted to the kindness of Mr. L. A. Boodle, A.R.C.S., for having shown me (in the Jodrell Laboratory, Kew) some sections of the leaf of *Lycopodium* in which the bundles show this structure very clearly.

† See Williamson and Scott, "Further Observations on the Organization of the Fossil Plants of the Coal Measures, Part III., *Lyginodendron* and *Heterangium*," Phil. Trans. B. 1896, p. 713.

and showing occasional transverse or oblique cross-walls. At *p* is seen a zone of cells occupying a position between the xylem and phloem—a position corresponding with that occupied by the cells shown at *p* in the transverse section (Pl. XXXVI. fig. 12) and doubtless representing modified cells of the inner sheath. Here the cells appear to be fairly thick-walled and exhibit great elongation in the vertical direction.

When the bundles enter the outer cortex various points of interest arise. Pl. XXXVI. fig. 6 is from a photograph of a portion of a tangential section passing through the outer cortex and showing some of the emerging leaf-trace bundles cut more or less transversely. It will be seen that below each bundle there is an empty space, *Pa.*, of considerable size. The same space is also seen in Pl. XXXVI. fig. 7, which is a photograph of a nearly radial section passing through the outer cortex and proximal end of a sporophyll. In the transverse section (Pl. XXXVI. fig. 1) a similar space, *Pa.*, is seen *behind* the vascular bundle, as already mentioned in the description of Williamson's figures. In the slides from which Williamson's figures were made the origin of this space cannot be determined, but in Pl. XXXVI. fig. 10, which represents part of a radial section, its continuity with the middle cortical space is clearly seen. In this figure, *i.c.* is the inner cortex, *o.c.* the outer cortex, and *l.t.* a leaf-trace bundle passing outward. The bundle is broken; but the continuity of the space *Pa.*, below the bundle, with the middle cortex space, *m.c.*, is quite clear. Unfortunately the tissue formerly occupying this space, as also the middle cortex itself, has entirely disappeared. Further reference to this space, which undoubtedly represents the tissue named the parichnos by Bertrand *, in the vegetative region, will be made in the description of Wild's Cone (*L. oldhamius* β).

Reverting again to Pl. XXXVI. fig. 7, a leaf-trace bundle is seen intersected longitudinally as it is passing into the pedicel of a sporophyll. The xylem is shown at *x.* and the phloem at *p.*′, while between the two is a rather thick-walled tissue *p.* Surmounting the bundle is a parenchymatous tissue *sh.*, and below the phloem the remains of a dark-looking tissue *sh.*′; doubtless both *sh.* and *sh.*′ represent the inner cortical sheath. On Pl. XXXVII. fig. 13 these structures are shown on a larger scale, the reference letters being the same as before. The remarkable development of the tissue between the xylem and phloem in this region is shown on Pl. XXXVII. fig. 14. This is from a radial section of a leaf-trace bundle in the outer cortex just as it begins to bend more sharply outward to the sporophyll. Here the tissue *p.*, between the xylem *x.* and phloem *p.*, is very strongly developed, resulting in the wide separation of the two latter tissues. The drawing represents the bundle in its natural position, and it will be seen that the cells *p.* are so arranged that their long axes are parallel, not with the length of the leaf-trace, but with the main axis of the cone.

Pl. XXXVII. fig. 15 is an enlarged drawing of one of the bundles shown in the tangential section through the outer cortex (Pl. XXXVI. fig. 6). The bundle is passing obliquely outward, and so is not cut quite transversely. At *x.* the xylem is shown; at *p*′. the phloem elements with quite thin walls; while between the two the fairly thick-walled tissue *p.* is seen. At *sh.*, *sh.* are some clear-looking cells quite distinct from those of the outer cortex *o.c.*, and doubtless representing the inner cortical sheath.

* "Remarques sur le *Lepidodendron Harcourtii*," Trav. et Mém. Facult. Lille, vol. ii. (1891), Mém. 6, p. 84.

Structures outside the Axis.—Unfortunately, in the sections of this form the structures outside the central axis of the cone are not well preserved. In the longitudinal sections the pedicels of the sporophylls are seen radiating out from the axis with a slight upward direction, and in the transverse section shown on Pl. XXXVI. fig. 1 sections of the sporophylls, *sph.*, are shown attached to the sporangia, *sm.*

Of the spores but little can be said. They are found singly and in tetrads. There is no evidence to prove whether the cone was homosporous or heterosporous, the only spores seen being from ·02 to ·03 millim. in length, which is about the usual size of the spores which are described among *Lepidostrobi* as microspores. No trace of the ligule can be seen in these slides, probably owing to the imperfect preservation of the outer portions of the strobilus.

On Pl. XXXVII. fig. 16 is shown a transverse section of one of the larger laminæ seen around the periphery in both the transverse sections (C.N. 1613 *d*, S. 85). A somewhat similar lamina is also shown at the periphery of the transverse section, Pl. XXXVI. fig. 1. As can be seen by a comparison of the sporophylls shown in these two figures, the pedicel, when traced from the axis outward, exhibits a progressive enlargement of its lateral wings, and when quite free from the sporangium (fig. 16) the lamina becomes of considerable size. In fig. 16 the vascular bundle is seen at *l.t.*, illustrating the typical uninervate character of the genus, while below it is a somewhat irregular space. The main tissue of the sporophyll is a thin-walled, small-celled parenchyma, passing at the periphery and at the edges of the leaf into a thicker-walled protective zone.

Pl. XXXVII. fig. 17 is a section of the thin edge of a lamina quite similar to that shown in fig. 16; it exhibits cells having an appearance somewhat similar to those of the outer cortex of the axis, and bounded by a distinct epidermis, *e*.

On Pl. XXXVII. fig. 18 is an enlarged drawing of the vascular bundle shown at *l.t.* in fig. 16. The xylem is seen at *x.* and the phloem at *p′.*, with isolated barred cells at *s.t.* The bundle appears distinctly collateral.

Pl. XXXVII. fig. 19 is the transverse section of two smaller scales from the periphery of the same section. Doubtless they belong to sporophylls inserted lower down on the axis. The outside of the cone was well protected by these overlapping free portions of the sporophylls, which doubtless extended upward for a considerable distance, gradually becoming smaller.

Pl. XXXVII. fig. 20 is an enlarged drawing of one of the bundles from fig. 19. Here the xylem, *x.*, appears to be completely surrounded by a thin-walled tissue (probably phloem), so that as the apex of the sporophyll is approached the bundle appears to become concentric instead of collateral.

LEPIDOSTROBUS OLDHAMIUS (β).

The general morphology of this form—the form originally described by Williamson as *L. oldhamius* *, which for convenience I propose to designate my β type—has been already described in the introduction. The sections to be specially considered now

* "Organization," Part XIX. p. 28.

(Wild's Cone, C.N. 1776 A, 1776 B, 1776 C) have been compared with Williamson's type slides and with other sections cut from the same specimen which are now preserved in the Binney Collection at Cambridge. So far as the corresponding structures can be compared in the absence of a transverse section of the newer specimens, the latter appear to be identical with those described by Williamson, and they will therefore be described as *Lepidostrobus oldhamius* (β). The *general* morphology is quite similar to that of the *L. oldhamius* (α) already described.

Structure of the Axis.—The axis is traversed by a central xylem cylinder, but unfortunately the specimen from which the longitudinal sections have been cut was in a somewhat flattened condition and the axial tissues disarranged. Notwithstanding this, the xylem elements are beautifully preserved. Pl. XXXVIII. fig. 24 shows some of the larger xylem elements in longitudinal section. As can be seen, they exhibit the scalariform type of thickening in a very perfect manner, and show also the very fine vertical striæ connecting the transverse bars so commonly seen in these old Lepidodendroid plants. This latter character, long thought by Williamson to be a diagnostic one of *Lepidodendron mundum*, Will., but afterwards shown to be equally characteristic of well-preserved tracheæ of other forms (including *Lepidodendron selaginoides*, *L. Harcourtii*, and *L. Wunschianum*), appears so constantly in the best-preserved sections of all these forms that it can hardly be referred to one of the effects of mineralization, but must rather be regarded as a structural peculiarity. These larger elements appear to be tracheides with very long oblique septa, and they have a maximum diameter of about ·04–·05 millim.

Some of the smaller, peripheral, xylem elements are shown on Pl. XXXVIII. fig. 25. They do not clearly show septa, and the thickening is often of a very loose nature (spiral ?). Doubtless the development of the xylem was centripetal, and these elements constitute the protoxylem.

Unfortunately, in none of the slides of this form is there any trace of the tissues between the periphery of the xylem and the inner cortical zone.

Bower * has described the structure of the axis of *Lepidostrobus Brownii*, Schimp., in which the axial tissues are completely preserved as far outward as the middle cortex. He has also recognized what he considers to be the endodermis, a band corresponding in position with the innermost layer of the cortex, distinguished by Hovelacque as the "*gaîne*" †. If this determination of the endodermis be correct, then the tissue between it and the xylem cylinder in *L. Brownii*, and representing presumably both phloem and pericycle, must have been exceedingly scanty. Opposite the points of the tracheal cylinder this tissue is only about 2 cells in radial thickness. Prof. Bower points out that if a true phloem was present it can have existed only in comparatively small quantity, and he proceeds to make a comparison with the Psilotaceæ, in which there is very little tissue referable to phloem.

Returning to *L. oldhamius* (α), Pl. XXXVI. figs. 1, 2, 3, & 5, it will be seen that the arrangement of parts is quite different. Here the space between the xylem and inner

* Ann. Bot. vol. vii.

† "Recherches sur le *Lepidodendron selaginoides*, Stern," Mémoires de la Société Linnéenne de Normandie, Caen, 1892, p. 52.

cortex is wide, and there is a comparatively thick covering of parenchyma around the woody cylinder. It seems certain that the phloem was very much better developed than in *Lepidostrobus Brownii*, Schimp. There is no evidence whatever in the latter species of a thick parenchymatous sheath around the xylem. The better development of the phloem in *L. oldhamius* is also shown by a comparison of the leaf-trace bundles as seen in transverse section in the middle cortex. In *L. Brownii* the phloem space is much *smaller* than the corresponding space in *L. oldhamius*.

Pl. XXXVII. fig. 23, *i.c.* shows the resistant band of inner cortex in *L. oldhamius* (β). It is seen to consist of about 6 or 7 radial rows of cells. It is thicker than in the α form, but the leaf-trace bundles traverse it, and each receives a sheath from it exactly as has been described.

Here again there are differences as compared with *L. Brownii* as described by Prof. Bower. Immediately outside the endodermis (in *L. Brownii*) there is a parenchymatous tissue with sclerenchymatous elements, which may be scattered singly or, as the outer part is reached, may preponderate and form a dense mass of tissue *. There is nothing in *L. oldhamius* to correspond with this.

Passing to the outer cortex, it will be seen to consist of a sclerenchymatous tissue. Pl. XXXVIII. fig. 26 exhibits some of the cells in longitudinal section. They have thick walls and an average diameter of about ·02 to ·03 millim. Many of these cells exhibit beautifully the cross striation of the thickened cell-wall so characteristic of some sclerenchymatous fibres (Pl. XXXVIII. fig. 27).

As can be seen from the drawing showing the outer cortex and proximal end of the pedicel (Pl. XXXVIII. fig. 28), and as can also be seen in transverse sections (see Williamson, "Organization," Part XIX. fig. 58), the outer cortex passes outward into, and forms the cortex of, the proximal end of the sporophyll. Moreover, it is mainly the cells passing up from below, accompanying the vascular bundle, which pass thus into the pedicel; the cells coming down from above appear to end abruptly against the outgoing tissue.

The outer cortex of this form differs from that of *L. oldhamius* (α) in (1) the general greater length and smaller diameter of the cells in the former type, in which all the cells are distinctly fibrous, whereas in the latter most of the cells are not much longer than wide; and (2) in the β form the cells do not exhibit the peculiar preservation of (apparently) cell-contents characteristic of *L. oldhamius* (α). (*Cf.* Pl. XXXVI. fig. 8 & Pl. XXXVIII. fig. 26.)

The cortex of *L. Brownii* differs from that of *L. oldhamius* not only in the features already mentioned, but also in the relative thickness of the three zones into which it is divided. It will readily be seen by comparison of Bower's figure, pl. xvi. fig. 1, and my Pl. XXXVI. fig. 1, that in *L. Brownii* the inner and outer cortical zones are both thicker, while the middle cortical space is evidently narrower.

The Leaf-trace Bundles and Sporophylls.—As already mentioned, these sections are specially valuable on account of the good preservation of the sporophylls and sporangia,

* Bower, in Ann. Bot. vol. vii. p. 336.

organs which are commonly crushed or destroyed even in those specimens showing good axial structures.

So far as the origin of the bundles and their passage through the inner space, inner cortex, middle cortical space, and outer cortex is concerned, there is nothing to distinguish this from the (α) form before described. The bundles traversing the middle cortical space distinctly show the remains of two sheaths: one surrounding the xylem only, and the other, the ordinary inner cortical sheath, investing the whole bundle.

Pl. XXXVIII. fig. 29 is a vertical section of a bundle in this region; it does not pass centrally through the bundle, and so escapes the phloem space; it shows, however, the mesarch nature of the xylem, *x.*, and the cells of the inner cortical sheath, *i.c.sh.*

Examination of the radial section preserved in the Binney Collection at Cambridge shows indications of the same peculiar arrangement of cells between the xylem and phloem of the leaf-trace when in the outer cortex, as is illustrated on Pl. XXXVII. fig. 14 in *Lepidostrobus oldhamius* (α).

Pl. XXXVIII. fig. 30 is part of a tangential section of the cone, magnified ten times. It shows the pedicels, cut approximately in transverse section, each supporting a single sporangium on its upper surface. Each sporangium is filled with spores.

Pl. XXXVIII. fig. 31 is an enlarged drawing of one of the sporophylls and adjacent sporangia, from the same section as that figured by Williamson, "Organization," &c., Part XIX. pl. 6. fig. 61. The pedicel is cut transversely, and the section passes so near the main axis of the cone as to escape the attachment to the sporangium. It exhibits a triangular form, and consists mainly of a sclerotic cortex, *c.*, continuous with the outer cortex of the axis. The vascular bundle is seen towards the upper surface, the xylem, *x.*, being preserved, while the phloem, *p.*, is represented only by a space. Surrounding the whole bundle is a parenchymatous sheath, *i.c.sh.*, doubtless representing the inner cortical sheath. Below this is seen the large parichnos space, *Pa.*, which was doubtless originally filled with tissue continuous with the middle cortex of the axis.

The parichnos in the vegetative region of *Lepidodendron* has been described by Bertrand *, Hovelacque †, and Williamson ‡, who have shown that the leaf-trace while traversing the outer cortex of the stem is accompanied by a distinct strand of specialized cells, and that before entering the leaf-base this strand, which Bertrand named the parichnos, bifurcates, the two arms bending away right and left of the leaf-trace, so that the bundle in the cushion (leaf-base) is accompanied by two strands of tissue, one on either side. There is no indication of such a bifurcation in the parichnos of the sporophyll; this difference may, perhaps, be correlated with the small width of the proximal end of the pedicel as compared with that of the leaf-base on the vegetative stem.

Pl. XXXVIII. fig. 32 is a section similar to the last, but cut at a somewhat greater distance from the axis. (N.B. This drawing is magnified to more than double the scale of fig. 31.) The pedicel has here lost its triangular outline and is becoming distinctly winged, while above, the attachment is shown to the sporangium. Apart from these differences,

* Trav. et Mém. Facult. Lille, vol. ii. (1891), Mém. 6.

† Mém. Soc. Linn. Normandie, 1892.

‡ "Organization," &c., Part XIX., Phil. Trans. 1893.

however, the structure is quite similar: at *c.* is the sclerotic cortex, bounded externally by a well-marked zone of smaller cells constituting an epidermis; at *x.*, the xylem; *p.*, the phloem space; *i.c.sh.*, the remains of the inner cortical sheath; and *Pa.*, the parichnos space.

The attachment to the sporangium is shown to be quite narrow; and passing up into the cavity of the sporangium is a mass of parenchymatous tissue, *b*, which, spreading out laterally, occupies a considerable portion of the floor and walls of the cavity, being thickest immediately above the line of insertion and gradually thinning-out laterally. At *sp.w.* is the sporangial wall, consisting of a single layer of palisade-like cells.

Pl. XXXVIII. fig. 33 is a longitudinal section through much the same region of the pedicel as in the last figure, and we see here the same tissues. At *b* is the pad of parenchyma forming the floor of the sporangium; as can be seen in fig. 32, it is continuous with the cells forming the sheath *i.c.sh.* around the leaf-trace, near to which the cells become more elongated in the direction of the length of the bundle, as shown in fig. 33. This tissue invariably contains a number of characteristic cells with dark contents; some of these cells are shown in figs. 32 and 33.

At *x.* (fig. 33) is the xylem, consisting as usual of scalariform tracheæ, below which the rather abundant tissue *p.*, consisting of small elongated elements, appears to be the phloem. Below this, again, come the large clear-looking cells of the inner cortical sheath, *i.c.sh.* The parichnos space, *Pa.*, is shown, as well as the sclerenchymatous elements of the cortex, *c.*

Reverting to Pl. XXXVIII. fig. 28, which shows the outer cortex and proximal end of the sporophyll in nearly radial section, it will be seen that the sporangium shows the attachment to the pedicel to within a short distance (1·6 millim.) of the axis of the cone. The distal point of attachment can be seen in Pl. XXXVIII. fig. 34, or better in my previously given figure illustrating the position of the ligule *. It will be seen that this point is quite close to the periphery of the cone, thus showing that the sporangium was attached to the pedicel by almost the whole length of its base. But although the attachment was thus a very long one, it was at the same time very narrow.

Sir Joseph Hooker, in his classical paper on *Lepidostrobus* †, gives a restored section (which has been copied into most of the text-books) in which the sporangium is shown attached to the pedicel only by a narrow neck of tissue near its outer end. In my figure ('Annals of Botany,' *loc. cit.*) precisely the same appearance is presented. In the latter case, however, it is due merely to the fact that, owing to the small tangential width of the attachment, the section has traversed it only near its distal extremity; and the same explanation, in all probability, can be applied to Hooker's sections, which I have examined in the Jermyn-Street Museum.

As Dr. Scott points out in his memoir on *Spencerites*:—"The attachment of the sporangium, either by the whole length of its lower surface or by a considerable part of it, to the upper side of the pedicel, appears to be constant in all species of *Lepidostrobus*

* Maslen, "The Ligule in *Lepidostrobus*," Ann. Bot. vol. xii. p. 258.

† "Remarks on the Structure and Affinities of some *Lepidostrobi*," Mem. Geol. Surv. vol. ii. part II. 1848.

where the preservation is sufficiently good for such points to be determined, and must, in my opinion, be regarded as an essential character of the genus" *.

The ligule has been described and figured in a former contribution to the 'Annals of Botany,' and but little need be said about it here. Its position, quite close to the distal extremity of the line of attachment with the sporangium, and its distance (about 1·5 centim.) from the periphery of the axis of the cone, are of course consequent on the great elongation of the sporangium in the radial direction so characteristic of *Lepidostrobus*. Thus the whole of the horizontal (sporangium-bearing) portion of the sporophyll appears to be the homologue of the short leaf-base or cushion of the vegetative stem.

Passing to the free portion of the sporophyll, Williamson's figures already quoted show that at the periphery of the cone it expands in all directions, forming a somewhat peltate extremity. The downwardly-directed lobe is thick, and covers and protects the sporangia below. The upwardly-directed scale is represented in Williamson's and Binney's figures as being comparatively short. Pl. XXXVIII. fig. 34 shows, however, that each sporophyll extends for a considerable distance upward, and that the sporangia are therefore protected in a very complete manner.

The peltate extremity of the sporophyll is of course traversed by the leaf-trace bundle, associated with which are many short tracheides ("barred cells") forming a kind of transfusion-tissue, probably compensating somewhat, physiologically, for their uninervate character. Some of these short tracheides, which occur also in the vegetative leaves, are shown on Pl. XXXVIII. fig. 35.

Lepidostrobus oldhamius (γ).

Pl. XXXVII. fig. 21 is a photograph of the transverse section of a cone which, although clearly of the same general type as the forms already described, yet differs in certain details of its structure. Whether these differences are sufficient to constitute it a distinct species or not seems impossible to determine until more material is at hand. What is particularly needed is complete cones which can be cut up throughout their entire length so as to show what variations in structure, if any, take place in different regions in the same cone.

However, whether this be a distinct species of *Lepidostrobus* or only a variation dependent on the part of the cone from which the section was cut, or other reasons, it seems advisable, provisionally, to give it some special designation, and I therefore propose to call it the γ form of *Lepidostrobus oldhamius*.

The Williamson Collection contains several slides (C.N. 571, 578, &c.) referable to this form, as does also the collection of palæo-botanical sections recently transferred from the Botanical to the Geological Department of the Natural History Museum. Dr. Scott has also kindly allowed me to examine several slides in his collection (S. 75, 76, 77, 610, 615), from one of which (S. 610) the photograph, copied in Pl. XXXVII. fig. 21, was taken.

* Phil. Trans. B. 1898, p. 99.

Comparing this form, as illustrated by fig. 21, with the forms already described, it will be seen that the xylem cylinder *x.* is thin and the pith-cavity relatively large, points in which it resembles my α form, although the number of larger xylem elements in the radial direction is somewhat greater. The medulla can be seen in one of the longitudinal sections (S. 77) to consist of square-ended cells arranged in vertical rows and somewhat elongated in the vertical direction.

No trace of the inner cortex can be seen in fig. 21, but this is probably an accident of non-preservation consequent on the crushing to which the cones had been subjected previous to and during fossilization.

Comparison of this figure with Pl. XXXVI. fig. 1 will serve to bring out other differences. It will be seen that in the latter form the outer cortex is much thicker, and hence more resistant, a fact which may possibly account for the flattened form of the specimen shown in fig. 21. Another point of difference is to be seen in the much larger number of leaf-trace bundles cut across in the transverse section of the γ form. In C.N. 1613 *d*, S. 85 (Pl. XXXVI. fig. 1), and C.N. 568 (Pl. XXXVII. fig. 23) the number of such bundles (including those in the outer cortex) is about 30, whereas in S. 610 (Pl. XXXVII. fig. 21) the number reaches about 60.

The leaf-trace bundles are also very small, having a diameter (including the inner cortical sheath) of but little over ·1 millim.; whereas those of C.N. 568 (Pl. XXXVII. fig. 23, my β form) are quite twice that size. There is, however, closer agreement in size when compared with the α form, in which the leaf-trace bundles have a diameter of about ·15 millim.

On the whole this form agrees, in the diameter of the whole cone, the diameter of the axis of the cone and of the leaf-trace bundles, the thickness of the xylem cylinder, the large pith, &c., more closely with my α type, from which it differs, however, in the thinness of the outer cortex, the large number of leaf-trace bundles, the small diameter of the vascular cylinder, &c. As compared with my β type the differences are still more accentuated: the thickness of the vascular cylinder is much less, the pith is relatively much larger, the cone itself is smaller, while the leaf-trace bundles are only half the size but double the number.

It is interesting to find in the *Lepidostrobi* much the same series of graduations between forms in which the vascular cylinder is very thin and those in which the vascular axis is nearly solid, *i. e.* without pith, as Williamson described in the vegetative axes of *Lepidodendron*. Starting from forms such as that represented on Pl. XXXVI. figs. 1 & 2, in which the vascular ring is very thin indeed, we pass through forms like Pl. XXXVII. fig. 21, in which the number of elements in the radial direction is somewhat greater, to Pl. XXXVII. fig. 23, in which the pith is much reduced in size, finally reaching the forms described by Williamson as *Lepidostrobus Traquairia*, in which the pith consists of but a few cells only*.

With regard to this latter form (*L. Traquairia*, Will.), which, from association, Prof. Williamson was led to believe is the strobilus of which the curious objects known

* See Williamson, "Organization," Part X., Phil. Trans. 1880, pl. 21. fig. 82.

as Traquairiæ are the macrospores, but little can be added. An impartial examination of the slides on which he based this conclusion (C.N. 1063–1071), taken in conjunction with the way in which we know that vegetable structures are crushed on and in one another, leads one to the conclusion arrived at by Count Solms-Laubach, who says, speaking of these same slides: "I have seen these preparations in his collection, and I must acknowledge that small groups of Traquairiæ or single Traquairiæ do lie inside many of the sporangia. But the whole specimen is so macerated that these might well have found their way in from the outside while it was rotting in the water, especially as other sporangia of the same cone contain small remains of tissue, which could not have got there in any other way"*.

That the sections are those of a strobilus is certain, and as in all probability it is a *Lepidostrobus*, it is an interesting coincidence, if nothing more, to find in a slide belonging to Dr. Scott (S. 83) much the same type of axis (the vascular axis alone is preserved) again associated with Traquairiæ. In this section, however, the diameter of the vascular axis is 2 millims., whereas in the type slides of *L. Traquairia* it is about 1·2 millim.; this increased size in the former being accompanied by an increase in the magnitude of the pith, the actual *thickness* of the vascular ring being the same in both cases. The pith-cells (in S. 83) have the appearance of being in an actively meristematic condition.

On Pl. XXXVII. fig. 22 I have given a diagrammatic representation of part of the cone of the *Lepidostrobus oldhamius* type, as seen in radial longitudinal section and magnified about four times. It differs from the restoration of the same cone given by Williamson † in some details, as will be seen by comparison of the two figures. The longitudinal course of the leaf-trace bundles in the axis is shown, as well as the origin of the parichnos space, *Pa.*, from the middle cortex; the position of the ligule, *li*, is indicated, and the great upward extension of the sporophyll laminæ, *la*.

Lepidostrobus foliaceus, sp. nov.

As already mentioned, this form was figured by Williamson ("Organization," &c., Part XIX. fig. 57, Phil. Trans. B. 1893), but the sections of this type at present known are insufficient to enable me to give anything like a complete account of the strobilus. However, there is no doubt as to its specific distinction from forms of the *L. oldhamius* type.

Referring to Williamson's figure, it will be seen that the specimen is incomplete below, while the apex is well preserved. The cone is small, very much smaller than any of the other forms described, its diameter being only about 1 centim., while that of *L. oldhamius* is between 3 and 4 centims. The length of the specimen as preserved is about 2·5 centims. Unfortunately the section is not quite radial, and so the axis is scarcely reached; but the thin upwardly-directed pedicels are well shown, each bearing on its upper surface a single radially-elongated sporangium.

* Solms-Laubach, 'Fossil Botany' (English translation, 1891), pp. 184–185.

† "Organization," Part XIX., Phil. Trans. B. 1893, pl. vi. fig. 62.

If this figure (Williamson's fig. 57) be compared with the one showing a radial section of *Lepidostrobus oldhamius* given by Binney *, or diagrammatically represented in my Pl. XXXVII. fig. 22, it will be seen that in the latter species the pedicels leave the main axis nearly at right angles, whereas in *L. foliaceus* they form an oblique angle with it.

The most characteristic feature, however, of this cone is seen in the free portions (laminæ) of the sporophylls. The pedicel is narrow, and it forms, at the periphery of the cone, the usual somewhat peltate expansion. Pl. XXXVIII. fig. 36 exhibits five of the sporophylls and sporangia in nearly radial section, magnified about nine times. The pedicel is seen at *p.* and the upwardly-directed lamina at *la.*, while *sp.* are the sporangia, each filled with small spores. As will be seen in Williamson's original figure, the laminæ belonging to the upper sporophylls bend over so as to completely cover the apex of the cone. On Pl. XXXVIII. figs. 37 & 38 is shown the pedicel in transverse section. The xylem of the trace is shown at *x.*, and this is surrounded by a thin-walled tissue which extends upward in the usual manner into the cavity of the sporangium. A fairly well-defined epidermal layer of thick-walled cells can be seen in fig. 37, while fig. 38 shows that in this species the sporangium is supported on a distinct stalk (which is, of course, in reality a longitudinal ridge passing along the lower surface of the sporangium) quite free from the tissue of the pedicel itself, and having a bounding layer continuous with the wall of the sporangium, *sp.w.* A characteristic feature is the presence of two pads of sclerenchyma, *sc.*, consisting of elements with very thick walls, and serving as lateral supports for the sporangium.

In none of the slides examined (C.N. 1614, S. 1, S. 2, &c.) is any distinct evidence of a parichnos space to be made out, but the sections are not sufficiently perfect to enable me to definitely affirm its absence.

The wall of the sporangium, *sp.w.*, is quite of the ordinary type, and consists of a single layer of cells.

Pl. XXXVIII. fig. 39 is from a photograph of a transverse section through the free portion of a sporophyll belonging to this type. It consists of large-celled parenchyma quite different from that of the other forms (compare Pl. XXXVII. fig. 16), which passes, as the periphery is approached, into a smaller-celled, thicker-walled protective zone. The striking feature is the abundance of cells with very dark contents scattered quite indiscriminately through the central parenchyma. Of course the nature of the original contents of these cells cannot be made out, but probably they indicate a secretion of some kind, and these cells may perhaps be described as "secretory sacs." The vascular bundle is shown, the xylem, *x.*, being apparently completely surrounded by thin-walled tissue, probably indicating that the bundle was concentric. The section shows some of the characteristic short tracheides ("barred cells") apparently quite free from the xylem of the bundle.

The following may be taken as a provisional diagnosis of the new species :—

* '*Lepidostrobus* and some allied Cones,' Palæontographical Society, 1871, pl. 7. fig. 3. Figured as the cone of *Lepidodendron Harcourtii*, L. & H.

LEPIDOSTROBUS FOLIACEUS, sp. nov.

Lepidostrobus, sp., Will., 'Organization of the Fossil Plants of the Coal Measures," Part XIX., Phil. Trans. 1893, p. 27, fig. 57.

Cone small, about 1 centim. in diameter.

Sporophylls (pedicels) leaving the axis at an oblique angle; directed upward.

Pedicel (as seen in transverse section) with two "pads" of sclerenchyma serving as lateral supports for the sporangium.

Pedicel with a longitudinal ridge on its upper surface, appearing, in transverse sections of the pedicel, as a distinct stalk to the sporangium.

Laminæ of sporophylls composed of a large-celled parenchyma, many of the cells showing dark contents ("secretory sacs").

The researches above detailed have been carried on at the Natural History Museum while holding the Marshall Scholarship at the Royal College of Science, London. I am greatly indebted to Dr. D. H. Scott, M.A., F.R.S., for much valuable help and criticism, and to Dr. H. Woodward, LL.D., F.R.S., and Mr. R. B. Newton, F.G.S., for facilities to study and photograph the specimens in their charge at the Museum.

EXPLANATION OF THE PLATES.

PLATE XXXVI.

Lepidostrobus oldhamius (*a*).

Fig. 1. Part of transverse section of whole cone. *m.*, pith-cavity; *x.*, xylem of axis; *i.s.*, inner space with leaf-trace bundles; *i.c.*, inner cortex with leaf-trace bundles passing through it; *m.c.*, middle cortical space; *l.t.*, leaf-trace bundles; *o.c.*, outer cortex; *Pa.*, parichnos; *sph.*, sections of sporophylls; *sm.*, sporangia and spores. S. 85. × 6·5

Fig. 2. Transverse section showing vascular cylinder, inner cortex, and emerging leaf-trace bundles. *x.*, elements of the xylem; *p.*, parenchymatous elements surrounding the xylem cylinder, with short tracheides ("barred cells") at *s.t.*; *l.t.*, leaf-trace bundles in inner space; *i.c.*, inner cortex with leaf-trace bundles passing through it; *m.c.*, middle cortical space; *i.s.*, inner space. C.N. 1613 *d*. × about 150.

Fig. 3. Longitudinal section of the central cylinder. (The section is not radial, and so does not penetrate the pith-cavity.) *x.*, xylem; *p.*, investing parenchyma with short tracheides at the periphery of the xylem cylinder. C.N. 1613. × about 160.

Fig. 4. Two of the short tracheides from C.N. 1613. × 210.

Fig. 5. Longitudinal section passing tangentially through the smaller peripheral elements of the xylem. (From a photograph.) *a.*, vascular axis surrounded by parenchyma *p.*; *l.t'.*, leaf-trace enclosed in the parenchymatous investment of the vascular cylinder; *l.t''.*, leaf-trace in inner space; *l.t'''.*, leaf-trace in outer space (middle cortical space); *i.c.*, inner cortex. C.N. 1613. × 54.

Fig. 6. Tangential section through outer cortex, showing emerging sporophyll bundles. (From a photograph.) *Pa.*, parichnos. C.N. 572. × about 20.

Fig. 7. Part of radial section showing the proximal end of a sporophyll and its vascular bundle. (From a photograph.) *o.c.*, outer cortex of axis; *sh.* and *sh'.*, sheath of cells continuous with those

of the inner cortex; *x.*, xylem of the leaf-trace; *p.*, tissue between xylem and phloem; *p′.*, elongated cells of phloem; *Pa.*, parichnos; *i.r.*, intruded Stigmarian (?) rootlets. C.N. 1613. × 50.

Fig. 8. Longitudinal section of cells of outer cortex. C.N. 1613. × about 180.

Fig. 9. Transverse section of cells of outer cortex. S. 85.

Fig. 10. Radial section of periphery of cone and proximal end of a sporophyll to show the origin of the parichnos space from the middle cortex. *i.c.*, inner cortex; *m.c.*, middle cortical space; *o.c.*, outer cortex; *l.t.*, leaf-trace (accidentally broken across); *l.t′.*, leaf-trace just leaving inner cortex; *Pa.*, parichnos space. C.N. 1613. × 23.

Fig. 11. Longitudinal section of leaf-trace (sporophyll) bundle in the middle cortical space. *i.c.sh.*, *i.c.sh′.*, sheath continuous with inner cortex; *x.*, xylem; *p.*, elongated cells between xylem and phloem; *p′.*, phloem. C.N. 1613. × 180.

Fig. 12. Transverse section of leaf-trace (sporophyll) bundle in the middle cortical space. *i.c.sh.*, sheath continuous with inner cortex; *x.*, xylem; *p.*, remains of cells between xylem and phloem; *p′.*, phloem space. C.N. 1613 *d.* × 150.

Plate XXXVII.

Lepidostrobus oldhamius (α) continued.

Fig. 13. Enlarged drawing of the leaf-trace bundle from fig. 7. *sh.* and *sh′.*, sheath of cells continuous with those of the inner cortex; *x.*, xylem; *p.*, tissue between xylem and phloem; *p′.*, phloem; *Pa.*, parichnos space; *c.*, cortex. C.N. 1613. × about 160.

Fig. 14. Radial section through a leaf-trace bundle in the outer cortex just as it is bending out to pass into the sporophyll. *x.*, xylem; *p.*, cells between xylem and phloem; *p′.*, phloem. C.N. 1613. × about 160.

Fig. 15. Tangential section through the outer cortex, with an emerging leaf-trace bundle. *sh.* and *sh.*, sheath of cells surrounding the bundle and continuous with the inner cortex; *x.*, xylem; *p.*, tissue between xylem and phloem; *p′.*, phloem; *Pa.*, parichnos space; *o.c.*, outer cortex. C.N. 572. × about 150.

Fig. 16. Transverse section of one of the larger ascending sporophyll-laminæ from the periphery of the cone. *l.t.*, the trace. C.N. 1613 *d.* × about 30.

Fig. 17. Enlarged drawing of the thin edge of a leaf similar to fig. 16, showing a distinct epidermis, *e.* S. 85.

Fig. 18. The vascular bundle from fig. 16. *x.*, xylem; *p′.*, phloem; *s.t.*, short tracheides. C.N. 1613 *d.* × 120.

Fig. 19. Two smaller leaves from the same slide as fig. 11. C.N. 1613 *d.* × about 30.

Fig. 20. The vascular bundle from *l.t.*, fig. 19. *x.*, xylem; *s.t.*, short tracheides. C.N. 1613 *d.* × about 160.

Lepidostrobus oldhamius (γ).

Fig. 21. Transverse section of the axis of the cone. *x.*, xylem cylinder; *l.t.*, leaf-trace bundles; *Pa.*, parichnos space; *p.*, pedicel; *sp.*, remains of sporangia. S. 610. × 15.

Fig. 22. Diagram illustrating the general morphology of the cone of *Lepidostrobus oldhamius*. *a.*, axis of strobilus; *b.*, sporophylls and sporangia; *x.*, xylem and medulla; *i.c.*, inner cortex; *m.c.*, middle cortex; *o.c.*, outer cortex; *p.*, pedicel of sporophyll; *la.*, lamina of sporophyll; *li.*, ligule; *l.t.*, bundle; *Pa.*, parichnos; *sp.w.*, wall of sporangium. × 4.

Lepidostrobus oldhamius (β).

Fig. 23. Photograph of transverse section from Williamson's type slide, C.N. 568. *m.*, pith; *x.*, xylem cylinder; *i.c.*, inner cortex; *l.t'.*, leaf-trace bundles just free from the cylinder; *l.t.*, leaf-traces in the middle cortical space with xylem at x'. and phloem space at p'. × about 50.

Plate XXXVIII.

Lepidostrobus oldhamius (β) continued.

Fig. 24. Elements of the xylem. C.N. 1776 A.

Fig. 25. Smaller xylem elements. C.N. 1776 A.

Fig. 26. Longitudinal section showing the prosenchymatous cells of the outer cortex. C.N. 1776 A.

Fig. 27. A single cell of the outer cortex, showing striation of the cell-wall. C.N. 1776 A.

Fig. 28. Longitudinal section passing through the outer cortex and proximal end of a sporophyll. *o.c.*, outer cortex; *l.t.*, leaf-trace bundles; *x.*, proximal point of attachment of sporangium to pedicel; *sp.w.*, wall of sporangium. C.N. 1776 A. × about 11.

Fig. 29. Longitudinal section of leaf-trace bundle traversing the middle cortex. *x.*, xylem; *i.c.sh.*, inner cortical sheath. C.N. 1776 A.

Fig. 30. Part of tangential section of the cone, showing the sporophylls, each supporting a sporangium on its upper surface. C.N. 1776 A. × 10.

Fig. 31. Transverse section of the pedicel of a sporophyll cut near the axis of the cone, with the adjacent sporangia, *sp.* *x.*, xylem of leaf-trace; *p.*, phloem space; *i.c.sh.*, inner cortical sheath; *c.*, cortex; *Pa.*, parichnos space. C.N. 574. × about 35.

Fig. 32. Transverse section of the pedicel cut further from the axis of the cone and showing attachment to its sporangium. *x.*, xylem; *p.*, phloem space; *i.c.sh.*, inner cortical sheath; *c.*, cortex; *Pa.*, parichnos space; *b.*, parenchymatous tissue passing into the sporangium; *sp.w.*, wall of sporangium. C.N. 1776 A. × about 90.

Fig. 33. Longitudinal section of the pedicel. *x.*, xylem; *p.*, phloem; *i.c.sh.*, inner cortical sheath; *Pa.*, parichnos space; *c.*, sclerenchymatous cortex; *b.*, parenchymatous tissue in the sporangium. C.N. 1776 A. × 140.

Fig. 34. Longitudinal section at the periphery of the cone, showing the free portion of the sporophylls. *l.*, the ligule; *sp.*, sporangia and spores. C.N. 1776 A.

Fig. 35. Some short tracheides from the expanded portion of the sporophyll. C.N. 1776 C. × about 160.

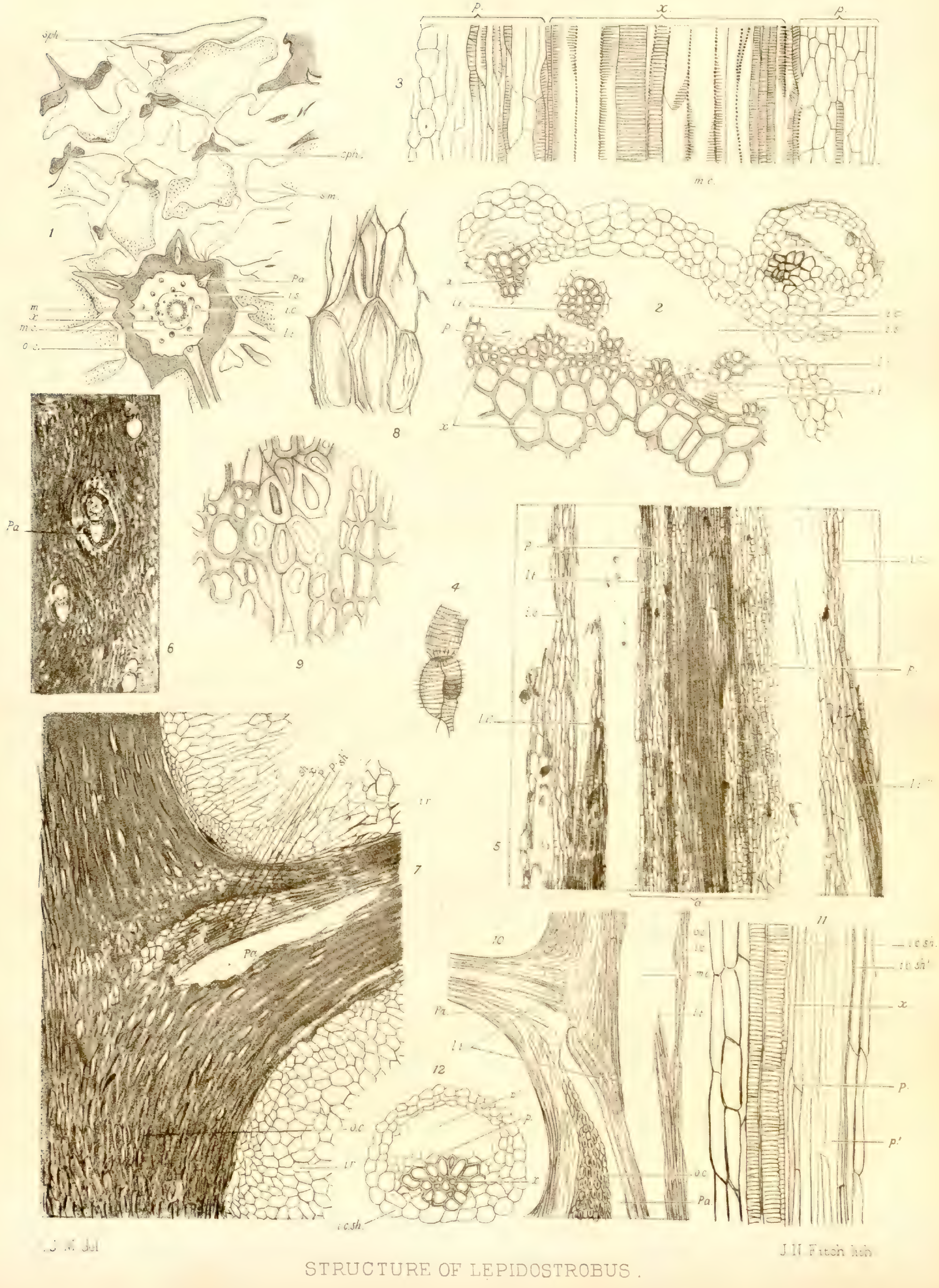
Lepidostrobus foliaceus, sp. nov.

Fig. 36. Nearly radial section of five of the sporophylls and sporangia. *p.*, pedicel of sporophyll; *la.*, lamina of sporophyll; *sp.*, sporangium and spores. C.N. 1614. × 9.

Fig. 37. Transverse section of pedicel supporting a sporangium. *x.*, xylem of leaf-trace; *sc.*, pads of sclerenchyma; *sp.w.*, wall of sporangium. C.N. 1922 F. × 50.

Fig. 38. Part of transverse section of pedicel. *x.*, xylem of bundle (displaced); *sc.*, sclerenchyma; *sp.w.*, wall of sporangium. S. 2. × 40.

Fig. 39. Transverse section of free portion of sporophyll. *x.*, xylem of bundle; *m.c.*, one of the cells with dense contents. S. 1. × 50.



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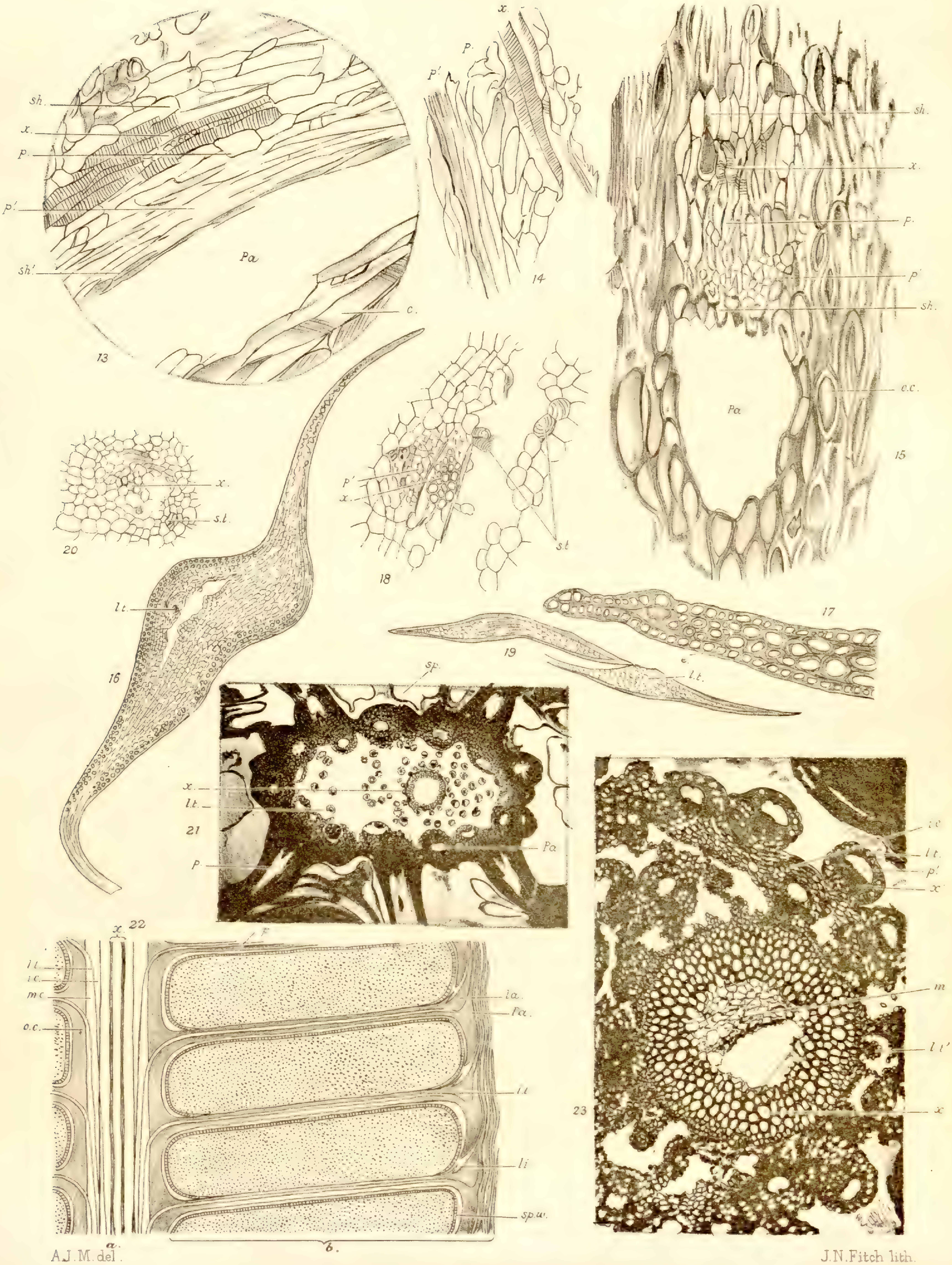
STRUCTURE OF LEPIDOSTROBUS.



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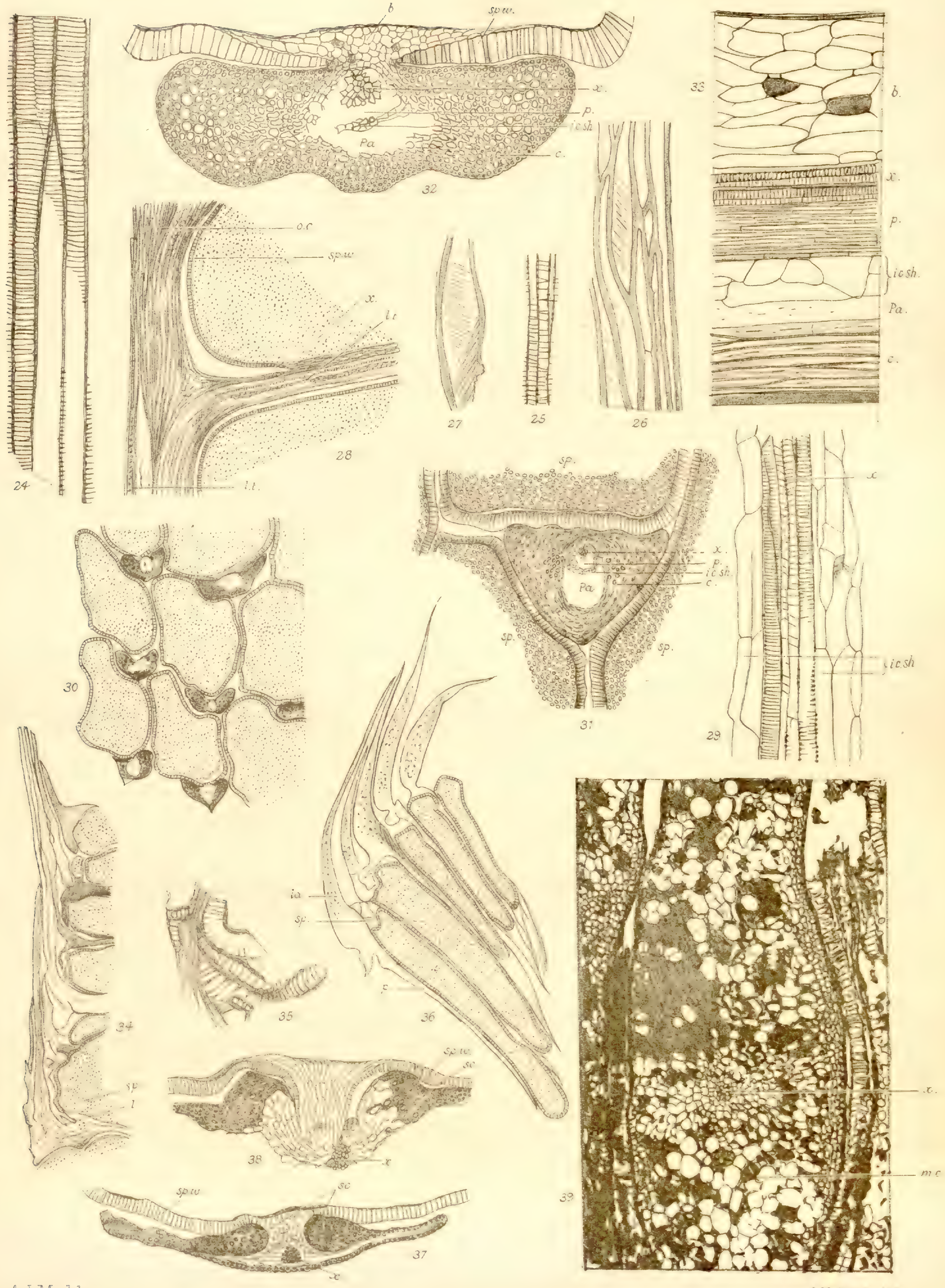

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STRUCTURE OF LEPIDOSTROBUS.

LINNEAN SOCIETY OF LONDON.

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	Part V.	1896.	0	14	0	0	10	6
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THE

TRANSACTIONS

OF

THE LINNEAN SOCIETY OF LONDON.

A SYSTEMATIC REVISION OF THE GENUS NAJAS.

BY

ALFRED BARTON RENDLE, M.A., D.Sc., F.L.S.

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December 1899.

XII. *A Systematic Revision of the Genus* Najas. By Alfred Barton Rendle, M.A., D.Sc., F.L.S., Assistant in Botany, British Museum.

(Plates XXXIX.–XLII.)

Read 15th June, 1899.

I. General Introduction.

1. *Historical.*

Dr. MAGNUS, to whom we owe an admirable account of the morphology and anatomy of the genus as well as valuable suggestions for its systematic division, gives also, in his 'Beiträge zur Kenntniss der Gattung *Najas*' (1870), an excellent historical introduction, tracing its history onward from Vaillant's description and figure under the name *Fluvialis* (in Mém. Math. Phys. Acad. Roy. Sci. 1719, p. 13, t. 1, fig. 2). Before this, however, Johann Bauhin (Hist. iii. 779 [1651]) had figured both *N. marina* and *N. minor* under the name *Fluvialis Pisana, foliis denticulatis*, and Plukenet in his 'Almagestum' (304, t. 216, fig. 4), in 1696, described and figured *N. marina* as a species of *Potamogeton* (*Potamogeiton fluviale Sargazo simile, lucens, foliis margine dentatis*). Plukenet's plant is preserved in the Sloane herbarium, in the Department of Botany, British Museum. Ray (Hist. iii. 121 [1704]) cites Plukenet's species, and also under *Fluvialis* a second, the *Flagellum Christi* of Cupani (Hort. Cath. 241 [1696]). On p. 132 he describes the latter, which he received from William Sherard, as the plant of the Hort. Cath. Mr. Druce finds the same in Sherard's herbarium at Oxford; it is a slender form of *N. marina*.

Vaillant describes the female flower as a one-ovuled ovary, the male as monopetalous and containing several stamens. He distinguishes two species which he observed near Paris, *Fluvialis vulgaris, latifolia*, and *Fluvialis angusto longoque folio*. The former, which he figures, is our *N. marina*, as is presumably also the latter. A third species is Ray's *Fluvialis*, and is therefore again *N. marina*. Micheli (Nov. Pl. Gen. 11 [1729]) also has three species, male and female plants of *N. marina* being described respectively as 4-seeded and 1-seeded species; the third is *N. minor*. He gives good figures of the habit, and is the first to separate the two species which Bauhin had confused.

Linnæus founded the genus *Najas* in his 'Genera Plantarum' (no. 701) in 1737; and in his 'Species Plantarum' (1015), in 1753, made one species *N. marina* with two varieties (β and γ). His varieties are simply Ray's two citations of the same plant, *Flagellum Christi*, and do not refer, as has been supposed, to *N. minor*. The specimens

in Linnæus's herbarium (written up by himself *Najas marina*) are all *N. marina* var. *angustifolia*. In the 'Genera Plantarum' *Najas* forms with *Zannichellia* and *Cynomorium* the order Monandria of Class XXI., Monœcia; in the 'Species Plantarum' it comprises the order Monandria of Class XXII., Diœcia.

In 1785 Allioni (Flora Pedem. ii. 221), ignoring Linnæus's species, united Micheli's first and second under the name *N. major*, and distinguished the third as *N. minor*. Schkuhr (Bot. Handb. iii. 252, t. 296 [1808]) was the first to recognize the difference between male flowers of the two species.

In 1801 Willdenow (in Mém. Acad. Roy. Sc. Ber. 1798, pt. i. 87) founded the genus *Caulinia*, in which he included *C. flexilis*, *C. fragilis* (= *N. minor*), and *C. indica*. R. Brown, however (Prodromus, 345 [1810]), reunited *Caulinia* and *Najas*, at the same time describing a new species, *N. tenuifolia*. Later Ascherson (Flora Prov. Brandenburg, i. 669 [1864]) divided the genus into two sections: *Eunajas*, containing *N. marina*, and *Caulinia*, with *N. minor* and *N. flexilis*.

A. Braun in the same year (in Journ. Bot. 1864, 274), in his 'Revision of the Genus,' retains Ascherson's sections. Braun's is the first attempt to deal with the whole material under the genus, and is an invaluable contribution to a systematic arrangement of the species, of which he distinguishes eight, with numerous varieties. For specific characters he relies primarily on the form of the leaf-sheath, secondarily on that of the leaf-teeth.

Magnus in 1870 followed with the 'Beiträge z. Kenntniss d. Gattung *Najas*,' to which we have already referred, by far the most important publication on the subject that had hitherto appeared. Of special value was his investigation of the flower and fruit, in the structure of which he indicated the important differences on which are based the specific characters adopted in the following arrangement.

The most important work since 1870 has been that of Magnus himself, who elaborated the genus for Engler & Prantl's 'Pflanzenfamilien'; of K. Schumann, who has monographed the Brazilian species in the 'Flora Brasiliensis'; of Morong, whose researches on the North-American species appeared in the publications of the Torrey Botanical Club; and of C. Bailey, who gave a valuable account of *N. graminea* in the Journal of Botany (1884).

2. *Morphological.*

The plants are small herbs growing completely submerged in fresh or brackish water, attached to the soil by fibrous roots springing from the base of the stem or the lower nodes of the branches.

The main stem branches shortly above the base. The branches may be long and spreading, giving a diffuse habit, or ascending from a decumbent base with a grass-like growth, or may form a much-branched system in which the lateral axes, growing with equal vigour to that of the main axis, entail a regular dichotomous, often bushy habit. Frequently the elongated shoots end in a bushy dichotomous growth.

The length of the internodes varies widely, according to the general habit. The internodes are usually unarmed, but in *N. marina* and some of its varieties bear short subconical or triangular teeth ending in a sharp brown spine-cell.

The leaves are apparently opposite; each pair consists, however, of a lower and an upper leaf on opposite sides of the stem. The edges of the sheath of the lower leaf overlap the sheath of the upper, which is amplexicaul. Examination of the growing-point shows that the upper leaf appears later than the lower, and at an appreciably higher level. Each pair forms a sharp angle with the one immediately above or below. Branching occurs only in the axil of the lower leaf, from the second pair following the cotyledon onward. In vegetative shoots, as Magnus has shown, the lowest leaf on the branch is reduced to a small scale bearing a vegetative bud in its axil, whereas in fertile shoots a flower occupies the place of this scale-leaf with its bud. The lowest developed leaf of the branch (*i.e.* the upper of the lowest pair), in which no bud arises, forms with the adjacent pair of leaves on the main axis an apparent whorl of three.

The leaves are sessile, the leaf-base forming a well-developed sheath, sharply distinguished from the blade. The sheath may appear truncate, in its natural amplexicaul position, from its widely-rounded shoulders, the sloping edges of which overlap; it may have more or less sloping shoulders; or it may be drawn out into longer or shorter auricles. The upper margins and auricles are generally more or less broken with small teeth or longer spine-bearing processes, the outgrowth in every case ending in a characteristic sharp yellowish-brown spine. The form of the sheath is generally constant for individual species and often for larger groups, and affords useful specific characters. Sometimes, however, as in *Najas indica*, the form varies widely even on the same plant (see Pl. XXXIX. figs. 34–37).

Within the sheath is a pair of minute hyaline cellular scales, which are generally subulate or filiform, or flat tapering from the base. Their shape is very variable, even on the same plant. They occur in connection with the cotyledon.

The leaf-blade may spread at a broad angle from the sheath or be more or less continuous with, and ascending from, it. It is generally narrow-linear, tapering above to the apex, and sometimes becomes setaceous; rarely is it broader and linear-lanceolate. The margin varies considerably. In the broader-leaved forms of *N. marina* it is sinuate-dentate, the teeth often exceeding in length the leaf-width, and ending in a strong yellow-brown spine with a base of several strengthening cells. There is every gradation between this and the structure in *N. graminea*, where simple marginal cells protrude in the form of ascending yellow-brown translucent spines visible only under a lens, the leaf appearing entire to the naked eye. In *N. marina* and several of its varieties, teeth similar to those on the internodes are found on the midrib on the back of the leaf. Similar dorsal spines occur in *N. lacerata*. As A. Braun indicated, the size and structure of the marginal teeth afford useful specific characters.

The internal structure of stem and leaf is extremely simple. It is most developed in *N. marina*, where a well-defined small-celled epidermis surrounds, in the stem, a many-layered parenchymatous cortex, the middle layers of which are separated by intercellular spaces. A narrow axial stele is bounded by a phlœoterma which shows well-defined endodermoid markings on the radial walls. The stele consists of much narrower, closely-packed parenchyma and a central cavity, which just below the growing-point is occupied with thin elongated cells and may be considered to represent tracheal elements. In the

leaf a similar epidermis surrounds a very large-celled mesophyll consisting only of a single layer at the edges, becoming two-layered as we advance inward, and separated towards the middle line on each side by a large intercellular space. A slender central axis similar to, but smaller than, that of the stem runs up the middle line, and is surrounded by one or two layers of mesophyll-cells.

The remaining species, forming the subgenus *Caulinia*, are even simpler in structure. An epidermis closely resembling the underlying cortical layer surrounds a cortex consisting generally of one or two outer layers, which is connected with an inner layer surrounding the stele by slender bands separating large intercellular spaces (see Pl. XLI. fig. 137, and Pl. XLII. fig. 149); the connecting-bands are, for the most part, only one cell thick. In *Najas horrida* (Pl. XLII. fig. 187) we find a more substantial cortex approaching that typical of *N. marina*. The leaves, which show some variation in structure, consist generally of two layers separated at a greater or less distance from the midrib by a larger or smaller intercellular space. The midrib comprises a narrow small-celled axis, like that of the stem, and surrounded by two layers of cells. Single cells, or groups of a few, in various positions may become thickened and fibrous supporting-cells; such developments may be constant for a given species, or, on the other hand, variations may occur within its limits.

The longitudinal intercellular spaces in the leaf are interrupted by transverse septa, to the strong development of which are due the horizontal lines running from the midrib towards the margin, which are characteristic of some species and occur on older leaves in others.

The flower, as Magnus as shown, originates in the following way:—A protuberance arises at the growing-point in the axil of the lower leaf of each pair before the appearance of the upper leaf. This protuberance becomes divided by a vertical furrow into a slightly larger (and lower) and a slightly smaller rudiment. The former develops into a flower, the latter into the axillary branch, at the base of which the flower is apparently borne in the mature condition. Sporogenous tissue develops in the apex of the rudiment, which becomes in the female the nucellus of an ovule, in the male the anther. In the female an annular wall grows up round the developing ovule; its margin becomes 2–3-lobed, according to the ultimate number of the stigmas, and, when fully developed, forms a closed chamber containing the ovule. The time and mode of origin of the outer envelope in *N. indica* and its allies have not been observed.

The integuments of the ovule arise, first the inner, then the outer, after the ovary-wall has become partly developed.

In the male a perfectly symmetrical ring arises round the base of the anther, and subsequently a second appears inside the outer and remains always closely adherent to the anther-wall, which, like itself, consists of a few (2) cell-layers. As Magnus states, and as Campbell has recently indicated in his account of the morphology of *N. flexilis* ('A Morphological Study of *Najas* and *Zannichellia*,' 1897), there is no sign of a midrib or of the division of these sac-like outgrowths into leaves. I have also examined many specimens, but have not seen any such indication.

This floral development is of great interest. First, the flower is produced by the

dichotomy of an axillary branch. Second, the archesporium is produced in the tip of the floral axis. Third, the homology of the envelopes is difficult to explain on the ordinary terms of definition of the parts of a flower.

In course of development the cup-like wall surrounding the ovule and the outer envelope of the anther are homologous, while the inner envelope, which remains closely adherent to the anther, corresponds with the integuments of the ovule.

Magnus proposes a very ingenious explanation. He regards the carpel-like structure in the female flower as the homologue of the cup-like envelope round the group of carpels in the allied genus *Zannichellia*. This arises similarly as an annular outgrowth of the floral axis, but surrounds more than one rudiment, each of which ultimately develops into an ovule surrounded by a stigma-bearing ovary-wall. Magnus suggests that the arrangement in *Najas* may have arisen from such a type by the suppression of all the ovules but one, and all the ovaries, leaving a naked ovule surrounded by a cup-shaped envelope (or perianth), which then developed stigmatic appendages. *Najas*, on this view, becomes a gymnosperm, the female flowers of which are provided with one, more rarely two, sac-like perianth-envelopes, corresponding with the two in the male.

K. Schumann (Mart. Fl. Bras. iii. pt. 3, p. 720) opposes this view, insisting on the homology of the stigma-bearing envelope (or ovary) in the female and the two-lipped inner envelope in the male. He regards the female flowers as always consisting of a naked ovary, and the male as enveloped with a single envelope which may be regarded as perigone or involucre at pleasure. He denies the existence of the similar envelope which Magnus had described in the female flower of *N. indica* and others. He was, however, occupied almost exclusively with South-American species, in which it does not occur. Investigation shows this outer envelope to be more generally present.

Campbell, in the memoir already referred to, draws attention to the primitive character of the flowers, and shows also that in *Zannichellia* we are dealing with a group of monocarpellary flowers, *i. e.* an inflorescence, not a single pluricarpellary flower.

It seems to me that the key to the whole arrangement lies in this primitive simplicity of the flower. We have in both male and female an axial structure containing sporogenous tissue which develops respectively into structures obviously comparable with normal anther and nucellus, the latter becoming surrounded by integuments forming a normal ovule. The ovule is surrounded by a cup-like outgrowth, which recalls the development of the ovary in *Polygonum* or *Rumex* (see Payer, 'Traité d'Organogénie,' pls. 64, 65), and which has the appearance and structure of an ovary. The inner envelope in the male flower I have regarded as a perianth. It is a lateral outgrowth of the floral axis below the andrœcium, which it protects, and has therefore the characteristics of a perianth which has arisen rather late in the history of the flower-development. The outer sac which characterizes the male, and is occasionally present in the female, I have called a spathe, remembering, however, that it is simply an outgrowth of the axis which ends in the flower below that flower. It is, I think, comparable with the spathe so characteristic of submerged monocotyledonous water-plants, which may have, moreover, a very similar appearance (e. g. *Lagarosiphon*, *Hydrilla*, &c.). It

will then correspond, as Magnus suggested, with the cup-like envelope in *Zannichellia*, which on Campbell's interpretation becomes a spathe surrounding an inflorescence, as in the Aroids. *Najas graminea* is exceptional in the absence of the spathe surrounding the male flower.

N. marina is diœcious; the other species in which both male and female flowers are known are monœcious. The few specimens of *N. lacerata* which I have seen bear only male flowers; the female and fruit are unknown.

When mature the flowers generally stand singly in the fertile sheath-axil, more rarely several together, a fertile shoot with suppressed internodes standing in the sheath-axil (Pl. XL. fig. 71). They are generally 2 to 3 mm. long. The male, as already indicated, consists of a sessile or subsessile anther closely surrounded by a thin membranous sac-like perianth, which ends above the anther in two thickened lips. The anther is more or less ellipsoidal or oblong in shape, has a delicate wall of two cell-layers, and is generally 4-, more rarely 1-locular. The cells are crowded with pollen-grains, oval or roundish in shape, both sometimes occurring in one anther, as in *N. graminea* (Pl. XLII. fig. 197); the grain has a single delicate uncuticularized wall, more or less filled with dark cell-contents, consisting largely of starch-granules. Campbell states that in *N. flexilis* the microspore divides into a larger vegetative and a smaller generative cell, which are separated by a membrane. The generative cell subsequently divides again.

In *N. graminea*, where the spathe is absent, the perianth forms two large ear-shaped lips above the anther (Pl. XLII. fig. 197).

The thin membranous spathe conforms below to the outline of the flower, but is prolonged above it into a cylindrical neck, which ends in a few of the characteristic spine-cells. A very short peduncle may be developed below the spathe; in *N. podostemon* it is almost as long as the flower. Before dehiscence of the anther the stalk elongates, pushing the anther, still closely enveloped by the perianth, through the spathe, which becomes split, sometimes laterally, sometimes from the apex downward. The lips of the perianth separate and the anther dehisces apically. (See Pls. XXXIX.–XLI. figs. 41, 51, 66, 94, 112, 120, 142.)

The female flowers are naked, consisting of a more or less ellipsoidal ovary produced into a narrow style, which divides into 2, more rarely 3, equal or unequal, linear-tapering branches provided with stigmatic papillæ. The single, erect, anatropous ovule almost fills the chamber, from the roof of which, just below the style, spring numerous elongated, papilla-like cells, which doubtless serve to conduct or nourish the pollen-tube; similar cells are also found at the base of the ovary just in front of the micropyle.

In a few tropical Old-World species the female flower is enveloped in a spathe closely resembling that of the male (Pl. XL. fig. 67).

As the flowers are always completely submerged, pollination must be effected by passive falling, by currents of water, or the transport of the pollen by aquatic animals. There is no evidence of the last-named. Magnus has observed the grains in *N. marina* to germinate before leaving the anther, the wall growing out into a long pollen-tube.

Jönsson (in Lunds Univers. Års-skrift, xx.) says that as the male flowers in monœcious forms stand higher on the shoot than the female which are mature at the

same time, the pollen-grains, when set free, fall, owing to their greater specific gravity from their richness in starch, on to the stigmas beneath. Magnus (in Engl. & Prantl, Pflanzenfam. ii. pt. 1, 216) thinks this unlikely, as the male flowers stand erect in the leaf-axil and the anther breaks through the apex of the spathe and dehisces at the top, so that the pollen would not fall directly upon a female flower beneath. But as he himself has figured for *Najas tenuifolia*, and as occurs in other species, the spathe may be split laterally and the anther, as I have seen in dried specimens, becomes pushed out beyond the sheath by the curved pedicel (see for instance Pl. XLI. fig. 120, *N. Kurziana*, and fig. 142, *N. foveolata*).

The fruit is narrowly ellipsoidal or oblong, enveloped, where this occurs, in the persistent spathe, and bearing the remains of style and stigmas. In fresh specimens of *N. marina* and *N. graminea* the pericarp-cells were turgid, forming a succulent coat; in the dried specimens the wall becomes very thin and membranous, generally clinging so closely to the seed as to take the impressions of the pitting on the testa. The seed has a conspicuous raphe which makes it slightly asymmetrical. The seed-coat is hard and brittle when dry, consisting in *N. marina* of many layers of cells with hard, thickened, pitted walls, surrounded on the outside by a row of very large cells with thin walls and clear contents, the side-walls having a delicate reticulate thickening. The raphe is distinguished by a group of thin-walled cells and several layers of large hyaline cells on the exterior. Ultimately the large, thin-walled, outer cells perish, and the testa consists of a stone-parenchyma, the surface of which is rugulose with irregular polygonal pittings. The thickness of the testa varies considerably in the different forms and varieties of the species. There may be as few as 4 layers of stone-cells or as many as 8 to 10. The innermost layers become much compressed tangentially by the growing embryo.

In the remaining species which form the subgenus *Caulinia* the testa consists, as Magnus as shown, of three layers, and shows three types, depending on the mode of development of the outermost layer. The cells of the innermost layer are thickened and become much flattened tangentially. Those of the middle layer are more nearly isodiametric and have very thick, hard, much pitted walls. In *N. flexilis* and *N. tenuissima* those of the outer layer become similarly thick-walled and pitted, and the seed has a smooth polished surface. In a second type, which is also the commonest (*N. minor*, *N. graminea*, *N. foveolata* and allies), the outer layer consists of large, clear, thin-walled cells with a delicate spiral thickening on the side-walls. The cells vary in shape in different species, giving the characteristic areolation to the testa. Thus in *N. minor* they are transversely elongated, giving a ladder-like appearance, in *N. graminea* isodiametrical. In a third type the outer and side-walls of the outermost layer are not thickened, but collapse, while the inner wall becomes thickened, and with its concave surface forms the shallow pits, rows of which give a characteristic marking to the seed-coat. Magnus points out that in *N. microdon* both the second and third form may occur on the same seed.

The large straight embryo completely fills the testa. It consists of a large hypocotyl and radicle, a well-developed lateral plumule, and a blunt terminal cotyledon. It was correctly described by Richard in 1811 (in Ann. Mus. Hist. Nat. xvii. 233).

Campbell shows that in *Najas flexilis* the oospore divides into an upper cell, which becomes much enlarged to form the primary suspensor-cell, and a lower or embryo-cell, which divides transversely into three cells. From the terminal segment is developed the cotyledon; from the outer half of the middle segment the growing-point of the stem appears as a lateral outgrowth; while the bulk of the root is formed from the same segment, only the initial plerome and terminal epidermis being formed from the lowest of the primary embryonic segments. No root-cap was present. The roots in the adult plants of *N. flexilis*, as of other species, have a root-cap (see fig. 196).

Affinity.—As already indicated, *Najas* forms a very distinct and apparently primitive type of Monocotyledon. Its nearest ally is *Zannichellia*, which resembles it in the axillary staminal structure and the female inflorescence; the latter is quite comparable, but contains within the spathe several flowers, instead of, as in *Najas*, a single flower only.

3. *Geographical Distribution.*

The genus is almost world-wide, occurring in all zones except the frigid. It is still unrecorded for certain areas in which it might be expected to occur, such as Tasmania and New Zealand; but the fact that it has not hitherto been found is scanty proof of its non-existence in any likely locality. The plants are often very small, and, growing completely submerged in water, are likely to be unnoticed, unless a collector is especially looking for them. Moreover the vicinity of water in warm climates often means fever, so that the general collector having no special keenness for *Najas* will naturally shun any likely locality.

Najas consists of a few widely-distributed, and a number of apparently more or less local species. *N. marina* (the only member of the subgenus *Eunajas*), a highly variable species with numerous varieties and forms, occurs over almost the whole area occupied by the genus, but finds its chief development in the north temperate region of the Old World. The type ranges from England, in the south of which it evidently was formerly more widely spread than at present (probably owing to the disappearance of suitable localities), through the central and, in a less degree, the southern portion of the continent of Europe; fossil fruits have been found in southern Scandinavia. In Asia it occurs in the Himalayan region (Cashmere) and in China and Japan. It will probably be found in Central Asia. It is also known from the north-eastern United States, the West Indies, and north-west Australia.

One variety only is very widely spread, namely var. *angustifolia*, which is plentiful in brackish water round the Baltic, and is also known from Assyria, Bourbon, Australia, and the Sandwich Islands. Of the rest, var. *intermedia* occurs in similar localities in the Baltic area and also in North Germany, Switzerland, South Russia, the Caspian Sea, and Afghanistan. Var. *Ehrenbergii* occurs in the South-Mediterranean area; var. *muricata* in Egypt and Ceylon; var. *americana* in the eastern and southern United States; and there is one in each of the following:—Germany, China, Canary Is., Florida, California, Mexico, Venezuela, and Brazil. The subgenus *Caulinia* has no such widely-distributed species. *N. minor* ranges from the south of Europe through Syria and Persia to Further India, and I have seen one small specimen from Manchuria. It has a variety (*tenuissima*)

in Scandinavia. *Najas graminea* is an Old-World tropical species. *N. flexilis* is temperate North American and north-west European. *N. microdon* is its representative in the warmer parts of America. The remaining species have all restricted areas and fall for the most part into small geographical groups, namely an Asiatic, Australian, Mascarene, African, and West Indian and tropical South American. The annexed table gives a general view of the distribution:—

Species.	North Temp.		Mediterranean.	Tropical Asia.	Australia.	Mascarene.	Tropical Africa.	S. Africa.	N. America.	W. Indies, Central & S. America.	Pacific Islands.
	Europe.	Asia.									
1. Najas marina	1	1	1	1	1	1	..	..	1	1	1
2. N. indica	..	..	..	1							
3. N. Schweinfurthii	..	..	..	..	..	..	1				
4. N. Welwitschii	..	..	..	..	..	..	1				
5. N. madagascariensis	..	..	..	..	..	1					
6. N. ancistrocarpa	..	1	..	..	..	..					
7. N. flexilis	1	..	..	..	..	..	..	..	1		
8. N. podostemon	..	..	..	..	..	..	..	..	..	1	
9. N. microdon	..	..	..	..	..	..	..	..	1	1	
10. N. punctata	..	..	..	..	..	..	..	..	..	1	
11. N. microcarpa	..	..	..	..	..	..	..	..	..	1	
12. N. Wrightiana	..	..	..	..	..	..	..	.	..	1	
13. N. conferta	..	..	..	..	..	..	..	..	..	1	
14. N. arguta	..	..	..	..	..	..	..	..	..	1	
15. N. minor	1	1	1	1							
16. N. Kurziana	..	..	..	1							
17. N. tenuissima	1										
18. N. gracillima	..	..	..	..	..	..	..	..	1		
19. N. Kingii	..	..	..	1							
20. N. lacerata	..	..	..	1							
21. N. foveolata	..	..	..	1							
22. N. falciculata	..	..	..	1							
23. N. brevistyla	..	..	..	1							
24. N. tenuifolia	..	..	..	..	1						
25. N. Browniana	..	..	..	..	1						
26. N. Leichhardtii	..	..	..	..	1						
27. N. australis	..	..	..	..	..	1					
28. N. setacea	..	..	..	..	..	1					
29. N. horrida	..	..	..	..	..	..	1				
30. N. interrupta	..	..	..	..	..	..	1	1			
31. N. graminea	..	1	1	1	1	..	1				
	4	4	3	10	5	4	5	1	4	8	1

I have no doubt that there are many species still to be found, and that exploration of fresh or brackish waters, especially in tropical Africa, Malaya, and South America, will yield interesting novelties and elucidate species which are at present insufficiently known. The hope of inducing botanists and collectors in various parts of the world to look out for this interesting little genus must be my apology for publishing what I am convinced is but a very incomplete monograph. Hitherto I have profited not only by the collections at the British Museum and Kew, but also by those at the Calcutta Herbarium kindly lent by Dr. Prain, and at Berlin, including Alexander Braun's types, for facilities in the study of which I have to thank Prof. Engler. Mr. Charles Bailey, Prof. W. R. Dudley of California, Dr. P. Zalewski of Warsaw, and others have also courteously sent me specimens.

II. Systematic Account.

Genus NAJAS.

Najas, Linn. Gen. Pl. no. 701 (1737), ej. Hort. Cliff. 437 (1737), et Sp. Pl. 1015 (1753); Allioni, Fl. Pedem. ii. 221 (1785); Jussieu, Gen. Pl. 19 (1789); Willd. in Mém. Acad. Roy. Sci. Berl. 1798, 85; Lam. Encycl. Méthod. t. 799 (1798 ?); Pers. Syn. ii. 551 (1807); Schkuhr, Bot. Handb. iii. 251 (1808); Cham. in Linnæa, iv. (1829) 498; Endlicher, Gen. Pl. no. 1656 (1837); Kunth, Enum. iii. 111 (1841); A. Braun in Journ. Bot. ii. (1864) 274, et in Sitzungsb. Ges. Naturf. Fr. Berlin, 1868, 17; Le Maout & Decaisne, Traité Gén. Bot. 649 (1868); Magnus, Beiträge Kenntn. Gatt. *Najas* (1870), et in Engl. & Prantl, Pflanzenfam. ii. 1. 214 (1889), et in Ber. Deutsch. Bot. Gesell. xii. (1894) 214; Benth. & Hook. f. Gen. Pl. iii. 1018 (1883); Morong in Mem. Torr. Bot. Club, iii. no. 2 (1893), 57; K. Schum. in Mart. Fl. Bras. iii. pt. 3, 717 (1894).

Caroliana, Rafin. Journ. Phys. Chém. &c. lxxxix. (1819) 259.

Caulinia, Willd. in Mém. Acad. Roy. Sci. Berl. 1798, 87; Endlicher, Gen. Pl. no. 1655 (1837); T. Nees, Gen. Pl. Fl. Germ. iii. (1845); Le Maout & Decaisne, Traité Gén. 649 (1868).

Fluvialis, J. Bauhin, Hist. Pl. iii. 779 (1651); Vaillant in Mém. Acad. Roy. Sci. 1719, 14; Micheli, Nov. Pl. Gen. 11 (1729); Adans. Fam. Plant. ii. 472 (1763); Pers. Syn. ii. 530 (1807).

Fucus, Tourn. Inst. Herb. i. 569 (1700); Mappus, Hist. Pl. Alsat. 113 (1742).

Hyas, Dumortier, Anal. Fam. Pl. 61 (1829).

Ittnera, C. C. Gmel. Fl. Bad. iii. 590 (1808).

Herbæ annuæ, aqua dulci vel subsalina stagnante vel fluitante submersæ, radicantes; *caules* tenues sæpe elongati, interdum dichotome ramulosi, inermes vel rarius aculeati; *folia* per paria approximata, in specie opposita vel ternatim verticillata, e vagina subbrevi anguste linearia, sinuato-dentata vel serrulata (dentes cum aculeo sæpissime unicellulari luteo-brunneo terminati, sæpe ad aculeum e margine protrusum reducti), uninervia, rarius in nervi dorso spinifera; *vagina* truncata vel rotundata, vel superne in auriculis plus minus producta, in margine superiore vel in auriculis plus minus spinifera, sæpe asymmetrica, præcipue in folio cujusque paris superiore; squamulæ intravaginales binæ minutæ lanceolatæ vel sæpius angustæ et lineares aut filiformes; monœciæ, rarius diœciæ; *flores* unisexuales specie axillares, e basi ramorum orti, horum folio primo oppositi; *masculus* monander ante anthesin sæpissime subsessilis et in spatha (quæ cum collo cylindrico ore spinifero instructa est) inclusus, monochlamydeus, perianthium apice bilabiatum ad antheram arcte applicitum; anthera terminalis sæpissime subsessilis, quadrilocularis, rarius unilocularis; *femineus* nudus, rarius cum spatha simplici velut in mari indutus, ovarium ovale, uniloculare, cum stylo simplici coronatum, stylus cylindricus in stigmata 2–3 linearia papillosa desinens, vel interdum processubus quoque oppositis spiniferis cum stigmatibus alternantibus instructus, ovulum solitarium basale erectum anatropum cum integumentis duobus circumdatum; *fructus* parvus a folii vagina sub medium inclusus, ellipsoideus vel oblongus, vel fusiformis, pericarpium tenue semini adhærens; *semen* brunneum vel flavescens, testa sæpissime strata tria, rarius plura exhibens, stratum externum varie evolutum demum sæpius degenerans, strata interna incrassata et indurata, præcipue, qua tria extant,

stratum medium; *embryo* magnus, rectus, macropodus, valde evolutus, ad testam conformans, endospermum nullum.

Per orbem terrarum, regionibus frigidis exceptis, dispersa. Species 31.

Subgenus 1. EUNAJAS, Aschers.

Dioica; testa e stratis cellularum induratarum pluribus (plus quam tribus) constructa.

Generally plants of a sturdier habit than in the second subgenus, with a greater tissue-differentiation in stem and leaf, showing a well-marked epidermis and a many-layered cortex in the stem, with several layers between the intercellular spaces and the stele. Leaf-teeth large, back of the leaf and internodes with similar teeth. Male flower enclosed in a spathe; anther 4-locular. Female flower naked, generally 3-styled.

One species . . . . *N. marina*, 1.

1. NAJAS MARINA, Linn. (Pl. XXXIX. figs. 1–30.)

N. marina, Linn. Sp. Pl. 1015 (β & γ inclusis) (1753), et Fl. Suec. [ed. 2] 345 (syn. Michelii excl.) (1755); Theden. in Vet. Acad. Handl. 1837 (1838), 241, t. 8, et in Flora, xxiii. (1840) 305, t. 3; Nyman, Consp. Fl. Eur. 685 (1882), et Suppl. ii. 289 (1890); Arth. Bennett in Journ. Bot. xx. (1883) 353, t. 241; C. Reid ex Strahan in Quart. Journ. Geol. Soc. lii. (1896) 479, et in Proc. Roy. Soc. lxi. (1897) 45; Hornem. Fl. Dan. t. 2121 (1834); G. Anderss. in Bot. Notis. 1891, 249, et Svensk. Växtvärld. Hist. 42, t. 34 (1896), et in Engl. Bot. Jahrb. xxii. (1896) 468, t. 4. fig. 13 (German translation); Morong in Mem. Torr. Bot. Club, iii. (1893) no. 2, 58, t. 65; A. Gray, Man. Bot. [ed. 6] 565 (1890); K. Schum. in Mart. Fl. Bras. iii. pt. 3, 723, t. 123. fig. 2 (1894); Mirbel, Exam. de la Division des Végét. en Endorhiz. et Exorhiz. t. 3, in Ann. Mus. Hist. Nat. xvi. (1810) (figures fruit, seed and embryo).

Var. *latior*, F. Muell. ex K. Schum. in Mart. Fl. Bras. iii. pt. 3, 725 (1894).

Var. *muricata*, Hartm. Handb. Skand. Fl. (ed. 9) i. 197 (1864); "stems prickly, with red joints." Specimen not seen, but probably only a form of *N. marina*.

N. fluvialis, Thuill. Fl. Paris (ed. 2), 510 (1799); L. C. Rich. in Ann. Mus. Hist. Nat. xvii. (1811) 233, t. 5. figs. 32, 33.

N. fluviatilis, Poir. in Lam. Encycl. iv. 416 (1795–96); et Ill. iii. 395, t. 799, fig. 1 (1823).

N. fucoides, Griff. Notul. Pl. Asiat. pt. iii. 182, t. 251 (1851).

N. latior, F. Muell. ex K. Schum. in Mart. Fl. Bras. iii. pt. 3, 804 (1894).

N. major, Allioni, Fl. Pedem. ii. 221 (1785); Cham. in Linnæa, iv. (1829) 498; Linnæa, ix. (1834) 515, t. 7, et x. (1835) 225, t. 1; Kunth, Enum. iii. 112 (1841); A. Braun in Journ. Bot. ii. (1864) 275; Schnizl. Icon. Fam. Nat. i. t. 71. figs. 1–11 (1843–46); Gris in Bull. Soc. Bot. Fr. xiv. (1867) 251; Roth, Tent. Fl. Germ. ii. pt. 2, 499 (1793) [the species is quoted *N. major*, Roth, as frequently as *N. major*, All.]; T. Nees, Gen. Pl. Fl. Germ. iii. 44, figs. 1–21, et 45, figs. 12, 13 (1845); Peterm. Deutsch. Fl. 539, t. 83, fig. 658 *a–l* (1849); Garcke, Illustr. Fl. Deutsch. [ed. 17] 566 (1895); C. A. Weber in Abh. Naturw. Ver. Brem. xiii. (1896) 462; Parl. Fl. Ital. iii. 662 (1858); Magnus in Nuov. Giorn. Bot. Ital. ii. (1870) 187; Irmisch in Flora xlviii. (1865) 83, t. 1. figs. 21–24 (germination); Boiss. Fl. Or. v. 27 (1884); Hook. f. Fl. Brit. Ind. vi. 569 (1893); Franch. & Savat. Enum. Pl. Jap. ii. 13 (1879); Benth. Fl. Austral. vii. 181 (1878); Britton & Brown, Ill. Fl. North U.S. i. 80, t. 179 (1896); Chapm. Fl. South Unit. States [ed. 2] 652 (1883); S. Watson in Geol. Surv. Calif., Bot. ii. 191 (1880); Griseb. Fl. Brit. West Ind. 507 (1864).

Var. *lævis*, DC. Fl. Franç. (ed. 3) ii. 587 (1805); var. *multidentata*, A. Br. in Journ. Bot. ii. (1864) 275; var. *spinulosa*, DC. *l. c.*; (?) var. *paucidentata*, A. Br. 276.

Najas monosperma, Willd. Sp. Pl. iv. 331 (1805); Pers. Syn. ii. 551 (1807); Sturm, Deutschlands Flora, Heft 41, no. 15 (1821).

N. muricata, Thuill. Fl. Paris [ed. 2] 509 (1799).

N. spinosa, Buch.-Ham. ex Wall. List, no. 5182.

N. polonica, Zalewski in Kosmos, xxi. (1896) 326.

N. pluvialis, K. Schum. in Mart. Fl. Bras. iii. pt. 3, 724 (1894), sphalm. = *fluviatilis,* Lam.

N. tetrasperma, Willd. Sp. Pl. iv. 331 (1805); Pers. Syn. ii. 551 (1807).

Ittnera Najas, C. C. Gmel. Fl. Bad. iii. 590, t. 3 (1808).

I. major, Reichb. Fl. Germ. Excurs. 150 (1830).

Fluvialis Pisana, foliis denticulatis, J. Bauhin, Hist. iii. 779 (right-hand fig.) (1651); Tourn. Hist. 196 (1698); Vaillant, Botan. Paris, 54 (1727).

Fluvialis species angusto brevique folio undequaque spinis infesta (Flagellum Christi), Cupani, Hort. Cath. 241 (1696); Ray, Hist. iii. 132 (1706).

Fluvialis species folio angusto, ad margines denticulis spinosis inciso, Flagellum Christi dicta, Ray, *l. c.* 121.

Fluvialis vulgaris latifolia, Vaillant in Mém. Acad. Roy. Sci. Ann. 1719, 13, t. 1, fig. 2. Male and female flowers are shown on the same plant; the former hanging from a leaf-sheath at the end of a stalk equal in length to the anther. The ovaries bear two stigmas.

Fluvialis angusto longoque folio, Vaillant, *l. c.* 14.

Fluvialis angusto brevique folio, Vaillant, *l. c.*

Fluvialis folliis angustis, dentatis, Vaillant, Bot. Paris, 54 (1727).

Fluvialis latifolia, fructu obtuso tetraspermo, Micheli, Nov. Plant. Gen. 11, t. 8, fig. 1 (1729), and

Fluvialis latifolia, fructu minus obtuso monospermo, ib. fig. 2. In both figures Micheli represents the plant as monœcious, with long-stalked male flowers. He rightly figures several fruits, but confuses fruit and seed with anther when he describes what is evidently a transverse section of an anther (fig. G) as a fruit with four loculi, and the four pollen-sacs (fig. H) as four seeds.

Potamogeiton fluviale Sargazo *simile lucens, foliis margine dentatis,* Pluk. Almag. 304, t. 216, fig. 4 (1696). Plukenet's plant is in Herb. Sloan. (vol. xcvii. fol. 122), where it is labelled in Plukenet's handwriting "*Fluvialis Pisana,* J. B. Tab. 216, f. 4"; Ray, Hist. iii. 121 (1706).

Fucus fluviatilis, aculeatus, undulatus, Tourn. Inst. Herb. i. 569 (1700); Mappus, Hist. Pl. Alsat. 113 (1742).

Najas fructu monospermo, Haller, Hist. Helvet. i. 238 (1768).

Sclerocarpus obliquus, C. A. Weber in Neu. Jahrb. f. Miner. Geol. u. Paläont. ii. 79 (1891). Specimen not seen; inserted on the authority of G. Andersson in Bot. Not. 1891, 253.

Dioica; fragilis, late ramosa, internodiis sæpe elongatis, interdum inermibus, interdum spinis paucis vel subnumerosis armatis; *foliis* in vivo rigidis, patentibus linearibus, sæpe late-linearibus, interdum oblongo-linearibus, super vaginam plus minus angustatis, apice mucronatis, margine dentibus validis patentibus spiniferis armatis, dorso sæpe parce spinosis; *vaginis* late rotundatis, inermibus, vel sæpe dente singulo vel dentibus paucis utrinque instructis; squamulis intravaginalibus minutis, sæpius subovatis, apice obliquis vel plus minus oblique truncatis; *floribus* solitariis: plantis masculis interdum cum foliis quam in femineis angustioribus, flore masculo cum spatha in collum apice paucispiniferum desinente circumdato, perianthio bilabiato ad antheram quadrilocularem subsessilem arcte applicito; flore femineo achlamydeo, ovario subgloboso vel late ellipsoideo, stylo cylindrico in stigmata linearia tria, rarius duo, diviso; *fructu* ellipsoideo vel ovoideo, apice subacuto, pericarpio crassiusculo; *semine* ad pericarpium conformante, testa rugulosa dura areolis plurangulis notata.

Size of the plant varying considerably, generally between 30 and 70 cm. A fruiting specimen from Hickling Broad, gathered in September, was 40 cm. long.

Plants attached at the base of the stem and at the lower nodes of the shoots by fibrous, often brownish-coloured roots. In the fresh state the stem and leaves are extremely brittle, the former breaking at a touch or with its own weight when lifted from the water.

Stem branching immediately above the base; shoots generally creeping at the lower nodes and ascending above. Internodes varying in length in different plants; the lower may be 6–12 cm. long; in the same plant they become much shorter from the base of the shoot upward, becoming suppressed near the apex; width varying (when dry) from 1 to 1·5 mm. (in fresh specimens 2·5 mm.); number of spines very variable, often few or none. *Leaf* 1·5 to 3·5 cm. long, often about 2 cm., 1 to 2·5 mm. broad. Teeth generally between 4 and 8 on each margin, though a much wider variation occurs; consisting of a conical outgrowth of the leaf-margin terminated by a strong, sharp-pointed, yellowish-brown cell; less than, greater than, or equal to the leaf-width; 1 to 4 similar spines occur on the back of the leaf. *Sheath* large and quite entire, or bearing on each of its rounded shoulders a very small tooth or one prominent tooth, which may be followed from above downward by one or a few smaller teeth, or there may be more than one prominent tooth or several inconspicuous ones; teeth ending in a sharp, yellowish, spiny cell; fertile sheaths generally very asymmetrical. Intravaginal scales varying much in shape on the same plant; generally about 6 mm. long, and tapering more or less obliquely from a broader base.

Male flower 3 to 4 mm. long; anther when young completely enveloped in the spathe and perianth, the cells of which contain a bright red sap; before dehiscence the short stalk grows and the flower is pushed through the spathe, which becomes split laterally; the perianth becomes torn, and the anther dehisces from above downward. *Female flower* when mature about 3·75 mm. long, the ovary occupying about one-third of the whole length; when three stigmas are, as usual, present, one is often smaller than the others. *Fruit* 4 to 8 mm. long, generally about 5 mm.; usually ellipsoidal or more or less ovoid, becoming narrowed at the top, where it bears the withered style and the remains of the stigmas; pericarp in fresh specimens turgid and succulent, but when dried thin and membranous; it is finally split by the growth of the seed, which is of a similar shape.

The general habit shows a wide variation, depending upon the length of the internode, the absence or presence of spines and their number, the greater or less rigidity of the leaves, their length and breadth, and the size and number of their marginal teeth. The size and shape of the fruit also vary considerably. The study of a large series of specimens reveals a number of forms which bear certain relations to geographic distribution, though doubtless largely determined by local conditions, such as depth of water, presence or absence of a current, strength of current, presence of salt, or temperature. As we might expect, these forms pass more or less one into another. I have purposely avoided attaching names to the following, which are fairly easy to distinguish :—

α. A luxuriant form with internodes much elongated and unarmed, or, especially the shorter upper ones, sparsely toothed. The leaves, which are uniformly linear or narrowing

above the sheath, are generally between 3 and 4 cm. long, and 2 to 4 mm. broad, including the teeth. The shallow teeth, of which there are 7 to 9 on each side, are less than, or rarely equal to, the leaf-width. The sheath is entire. The fruit is rather large, 5 to 6 mm. long by 2 to 2·5 mm. broad, ellipsoidal, narrowing towards the tip. (Pl. XXXIX. figs. 17, 18.)

N. fluvialis, Thuill. Fl. Par. [ed. 2] 510 (1799).

N. major, var. *lævis,* DC. Fl. Franç. [ed. 3] ii. 587 (1805).

Distributi [illegible] e seen specimens from the following localities:—

FRANCE—Seine, near Paris (*Houstoun* 1727, &c.), islands below St. Cloud, and near Charenton; Somme).

BAVARIA—Speyer; Erlangen.

POLAND—(*Woloszczak*, Fl. Polonica exsicc. no. 484).

ITALY—Venice (*Martens*).

JAPAN—Kiusiu (*Maxim.*, Iter Secundum); Hakone, prov. Sagami.

(?) CHINA—*Bretschneider*, Fl. Pekin. no. 892 (a fragment).

Fruits from neolithic deposits in Scandinavia, figured by G. Andersson (Svensk. Växtvärld. Hist. 42 t. 34, figs. *a* and *b*) may belong to this form. They are however, rather narrower than usual, being 6 mm. long by 1·7 to 2 mm. broad, and a determination from figure only must be very doubtful.

β. The common European form, with internodes sparsely armed and shorter leaves, generally 15 to 20 mm. long, more rarely reaching 25 mm. The marginal teeth, which are larger than in the preceding, are less than or sometimes equal in length to the leaf-width. The ellipsoidal or ovoid-ellipsoidal fruit is 4 to 5 mm. long by (generally) 2·5 mm. broad. (Pl. XXXIX. figs. 19, 20.)

N. major, var. *spinulosa,* DC. Fl. Franç. [ed. 3] ii. 587 (1805).

N. monosperma, Willd. Sp. Pl. iv. 331 (1805).

N. muricata, Thuill. Fl. Par. [ed. 2] 509 (1799).

I have seen specimens from the following localities:—

GREAT BRITAIN—Hickling Broad, Norfolk. Fruits found by Mr. Clement Reid in neolithic deposits, Glamorgan, in interglacial deposits at Hitchin, Herts, and in preglacial at Beeston, Norfolk, and Pakefield and Corton, Suffolk; (figs. 21–23).

FRANCE—Seine, at and near Paris; Loire at Chantenay; canal near Moret.

GERMANY—Strassburg; Mannheim; Carlsruhe; Bavaria; Bohemia; Dresden; Berlin; Tegel-see; Libbenz-see; Rybruck, Upper Silesia.

HUNGARY—Poet's Island in the Danube at Pressburg.

ITALY—Near Milan; Pavia; Ceraso (South Italy) (Herb. *Martens*).

SWITZERLAND—Near Zürich.

INDIA—Paingti (*Wall.* List, no. 5182). This is *N. spinosa*, Buch.-Ham.!, a fine plant with rather long leaves and very spiny internodes.

CHINA—Kianang (*Staunton*).

NORTH AMERICA—Onadaga lake, N.Y. (*Engelmann*).

JAMAICA—(*Wullschläger*).

AUSTRALIA—Flinders river, a fragment drifted up with the tide (*F. von Mueller* in Herb. Kew.); Murchison river, West Australia (*Oldfield*) (approaching var. *angustifolia*).

Specimens with pale-coloured narrowly ovoid fruit, spinous upper internodes, and leaves narrower in proportion to their teeth occur from Paris (*N. muricata*, Thuill.! and *N. major* var. *spinulosa*, DC.). Drawn-out examples affording a transition to var. *intermedia*, A. Br., in their narrow, proportionately larger-toothed leaves and slender fruit and seed, also occur. Such are specimens from Bavaria (Erlangen, in Herb. Roem.); France, in the Senig (South France), near Paris, and Montmorency; also Zealand (Sjælland), Sasaa, between Appenaes and Gaunö (south coast).

Fruits found by G. Andersson in neolithic deposits in South Sweden and Gothland may belong to this form. I have seen only a figure (Svensk. Växtvärld. Hist. 42, t. 34 *c*).

Fossil fruits are also reported by C. A. Weber from interglacial deposits in Prussia, Holstein, and Hanover (see Engler, Bot. Jahrb. xviii. Beiblatt 43 (1896), 6, and Nehring, Neues Jahrb. für Mineralog. 1895).

γ. A large-fruited form, also of widespread occurrence on the continent of Europe, characterized by larger patent leaf-teeth, 5 to 7 on each margin, and larger fruit, 5 to 6·5 or even 7·5 mm. long, 2·5 to 3·5 mm. wide (Pl. XXXIX. fig. 5). The internodes are more or less spiny, and the leaves generally about 2 cm. long.

I have seen specimens from the following localities:—

France—Arles, Gironde.

Germany—Moselle, near Coblenz; Tartaren-See (N.E. Prussia); Binowschen-See, Grünewald (near Berlin); Posen, in a lake 1½ mile N.W. of Lissa; Borowns-See.

Switzerland—Near Zürich (*Jäggi*).

Italy—Lago di Nemi, Monte Albano (*Martens*): var. *multidentata*, A. Br.! ex K. Schum. in Mart. Fl. Bras. iii. pt. 3, 725 (1894); no fruit.

Cashmere—Dal Lake; fruit 7 to 7·5 mm. long by 3 mm. broad.

Turkestan—Khiva (*Korolkow & Krause*); a fragment seen in Herb. Kew.

Cuba—(*Wright*, no. 3718).

A plant collected near Berlin (*Fritsche*), with shorter, narrower leaves, and fruit 5 by 2 mm., affords a transition to var. *intermedia*.

A very spiny specimen, the internodes bearing many (9 to 15) spines about 2 mm. wide, the large leaves 2·5 to 3·5 cm. long, bearing on each side 5 to 6 large teeth longer than the leaf-width, the asymmetrical sheaths with one to several small teeth on the shoulders, occurs from a lake near Kaltern, Tirol. The unripe fruit is 6 mm. long.

Var. recurvata, Dudley, Cayuga Fl. 104 (1886) (in Bull. Cornell Univ. [Science] ii., *ampliata*); Morong in Mem. Torr. Bot. Club, iii. (1893) no. 2, 59; A. Gray, Man. Bot. [ed. 6] 566 (1890); A. Britton & Brown, Ill. Fl. North U.S. i. 80 (1896). (Pl. XXXIX. figs. 9, 26.)

Planta internodiis plus minus spinosis, foliorum dentibus laminæ latitudinem æquantibus vel excedentibus; vaginis cum dentibus 1 vel 2, rarius 3, superne instructis; fructu minore.

Leaves from 1·5 to 2·5 cm. long and about 1 mm. broad, with 3 to 5 to 7 rather large spreading teeth on each side, and generally 3 on the back. *Fruit* 4 to 5 mm. long by 1·5 to 2 mm. broad.

NORTH AMERICA—Buffalo (*Clinton*); Rochester, Onadaga lake, N.Y.; Cayuga marshes, N.Y. (*Dudley*); Utah (*Parry*, no. 32); Santa Cruz river, S. Arizona (*Palmer*, no. 249); Florida.

Resembles the form γ of the type in its prominent leaf-spines, though the leaves are smaller, β in its medium-sized fruit.

This is a more widely spread MS. variety of Braun's, in which var. *recurvata*, Dudley, must, I think, be included. Prof. Dudley's plant, from Cayuga marshes, New York, is a form with very sparsely spinose internodes, and slightly less prominent leaf-teeth.

One of the specimens from Florida on which Braun founded his variety has very slender leaves and approaches his var. *angustifolia*, recalling especially a type specimen from O-Wahu in Herb. Braun.

Var. EHRENBERGII, A. Br. in Journ. Bot. ii. (1864) 275; K. Schum. in Mart. Fl. Bras. iii. pt. 3, 725 (1894). (Pl. XXXIX. figs. 10, 27.)

Planta foliis linearibus margine cum dentibus numerosis laminæ latitudinem haud æquantibus instructa; fructu minore.

Somewhat densely leaved; leaves with 8 to 12 small teeth on each side, and 2 to 5 on the back; sheaths with generally 1 to 3 more or less prominent teeth on each shoulder. *Fruit* (where present) 3 mm. long by less than 2 mm. broad.

ARABIA—Dhofar Mountains, S.E. Arabia (*Bent*, no. 219). Similar to the Socotran plant.—Wady Djara and Wady Kamme (? spelling) (*Ehrenberg*). Internodes unarmed, leaves 2 to 2·5 cm. long, 1 to 1·5 mm. wide, sheaths with generally 2 rather prominent teeth. The type of Braun's variety; with this I include the following:—

NORTH AFRICA—Kafr Douan, Tunis (*Letourneaux*). Somewhat similar to the preceding, but with shortly muricate internodes and less regular, slightly more patent teeth; sheaths with generally 3 teeth on the shoulder.

SOCOTRA—(*Balfour*, no. 732) (*Schweinfurth*, no. 709). A sturdier plant, with much larger leaves, 2·5 to 3·5 cm. long and 1·5 to 2 mm. broad. The internodes are unarmed, and the sheaths have one or more teeth on the shoulder. No fruit.

Var. RIEDELII, K. Schum. in Mart. Fl. Bras. iii. pt. 3, 725 (1894).

Planta caulibus laxis pæne inermibus; foliis linearibus utroque margine dentibus patentibus numerosis, dorso spinis pluribus, vagina dentibus prominentibus 1 vel 2 instructis.

Leaves between 2·5 and 3·5 cm. long, 1 to 1·5 mm. broad. Marginal teeth one-half to two-thirds the leaf-width; as many as 22 on each side. The numerous (as many as nine) dorsal spines are borne on the slightly projecting midrib.

BRAZIL—Lago de Pertininga (*Riedel*).

The specimen has neither flowers nor fruit. The variety bears some resemblance to var. *Ehrenbergii*.

Var. ANGUSTIFOLIA, A. Br. in Journ. Bot. ii. (1864) 275. (Pl. XXXIX. figs. 13, 28.)

Laxa, internodiis sæpius inermibus, foliis longis anguste linearibus, dentibus brevibus dissitis, fructu minore.

Stem almost or quite unarmed. *Leaves* 2 to 4 cm. long, with 5 to 10 short outwardly-directed teeth on each side, unarmed or with a few spines on the back; sheath with 1, 2, or 3 small, rarely large, teeth on the shoulders. *Fruit* oblong, narrowed towards the subobtuse apex, 4 to 4·5 mm. long, 1·5 to 2 mm. broad.

EUROPE (Northern)—Brackish water around the Baltic. Christiansand (*Hornemann, Engelhardt, Nordstedt*); Warnemünde (North Germany) (*Link*); Slesvig-Holstein, "in Brackwasser haltigen Binnenseen" (*Hansen*, no. 948), (*Lessen*); Ostrobothnia, Austr. Quarken (*Siming*); Finland, "In maritimis parœciæ Perno" (*Sælan*); Mecklenburg, Dassower-See.

ASSYRIA—"Missul ad Ninivam" (*Bornmüller*, no. 1838).

TURKESTAN—A fragment in Herb. Kew.

INDIA—Jemadar ki Lundi, Kurrachee (*Stocks*, no. 464).

BOURBON—(*Commerson*).

SANDWICH Is.—(*Menzies*); "In arenis prope Hama-Ruru O-Wahu" (*Adoltz*).

Var. INTERMEDIA, A. Br. in Journ. Bot. ii. (1864) 276. (Pl. XXXIX. figs. 14, 29.)

N. marina, Linn., var. *genuina*, K. Schum. in. Mart. Fl. Bras. iii. pt. 3, 724 (1894), in part.

N. intermedia, Gorski in Eichw. Naturhist. Skizze von Lithauen, &c. 126 (1830).

N. maritima, Pall. Reise, i. 369, may belong here (1791).

Planta foliis parvis, anguste linearibus, cum dentibus conspicuis laminæ latitudinem sæpius excedentibus; vaginis utrinque dentibus singulis vel binis instructis; fructu quam in specie sæpius minore.

Internodes unarmed or, especially the upper, sparsely spinous. *Leaves* 1·2 to 2 cm., generally about 1·5 cm. long, with 4 to 7 teeth on each margin; sheaths with generally 1 or 2, rarely more, teeth on each side. *Fruit* usually 3 to 4 mm., sometimes 5 mm. long, 1·5 to 2·5 mm. broad.

BALTIC—Stockholm (*Nyman, Wikström, Hornemann, Andersson*); Åland (*Herb. Linn.*); Bleking (*Fries* and others); Westervik (*Torner*); Gefle Bay (*Ahlberg*); Skåren Is., Christiania fiord (*Leche*); Wolgast (*Marsson*).

GULF OF RIGA—Oesel Is. (*Werner*, no. 739 *b*; *Arensburg*).

GULF OF FINLAND—Mouth of Narora river (Herb. Fl. Ingricæ); Fagervik (*Hisinger*); Karawaldoi Is. (*Schmalhausen*).

GERMANY—Schlon-See, Rofen-See and Schlachten-See, (*A. Braun*); Salzigen-See (*Garcke*); lakes near Allenstein and Gilgenburg (E. Prussia) (*Caspary*), and near Zutzer (W. Prussia).

SWITZERLAND—Reichenau near Constance (*Leiner*); Robenhausen, Zürich (*Muret*).

RUSSIA—Ukraine, S.W. Russia.

ASIA—East shore of Caspian Sea; Afghanistan (*Griffith*, no. 5609).

Fruits found in neolithic deposits in Scandinavia by Gunnar Andersson and figured (Svensk. Växtvärld. Hist. 42, t. 34. fig. *d*) may belong here.

Var. MICROCARPA, A. Br. in Journ. Bot. ii. (1864) 276.

Var. *Bollei*, K. Schum. in Mart. Fl. Bras. iii. pt. 3, 725 (1894).

Minor, breviter ramosa, foliis anguste linearibus, dentibus, nisi inter flores, sæpe laminæ latitudinem haud æquantibus; fructu minimo.

Leaves 1 to 1·9 cm. long, ·5 to ·8 mm. broad, with 5 to 7 teeth on each side, which, except on the small branchlets, do not equal in length the leaf-width; generally 3 teeth on the back of the blade, and 1 to 3 rather prominent teeth on each shoulder of the sheath. *Seeds* deep reddish-brown, 2·5 mm. long by 1·5 mm. broad, oblong from an obliquely truncate base with a rounded apex, and marked with distinct polygonal reticulations.

GRAN CANARIA—Lagoon of Mashalomas (*Bolle* in Herb. Braun).

Approaches var. *intermedia*, but distinguished by its very small fruit and less prominent leaf-teeth.

Var. BREVIFOLIA, var. nov.

Ramosa, internodiis spinosis elongatis, foliis brevibus angustis cum dentibus marginalibus magnis contiguis patentibus laminæ latitudinem excedentibus, vaginis cum dentibus magnis singulis binisve prominentibus utrinque instructis; fructu mediocri ellipsoideo.

Leaves 1 to 1·5 cm., rarely 2 cm. long, 1 mm. wide between the teeth, of which there are 4 to 6 on each side, and generally 2, sometimes one only, on the back. *Fruit* obtuse above, rounded below, 4 to 4·5 mm. long by 2 to 2·5 mm. broad. Markings on seed-coat prominent, often pentagonal.

GERMANY—"Schlon-See bei Heringsdorf" ("in large quantities and reaching 3 feet in length") (Herb. Braun).

It has a characteristic appearance resembling a muricate form of var. *intermedia*.

Var. LATIFOLIA, A. Br. ex K. Schum. in Mart. Fl. Bras. iii. pt. 3, 725 (1894). (Pl. XXXIX. fig. 11.)

Najas latifolia, A. Br. in Journ. Bot. ii. (1864) 276.

Planta pro genere robusta, internodiis inermibus, foliis late linearibus vel lineari-lanceolatis, margine cum dentibus numerosis parvis, dorso cum linea prominula 5–7-spinosa instructo, vaginis integris vel minute denticulatis.

Internodes 1·5 to 2 cm. long, 1 to 1·5 mm. in width. *Leaves* 2 to 3 cm. long by 2 to 3 mm. broad, the margin regularly dentate, teeth 12 to 16, not exceeding ·5 mm. in length; a narrow dorsal wing bears 5 to 7 larger spines. Flowers and fruit absent.

TROPICAL SOUTH AMERICA—Lagoon of Valencia, near Caracas (*Gollmer*).

Var. GROSSEDENTATA, var. nov. (Pl. XXXIX. fig. 16.)

Dense ramulosa, foliis brevibus crassiusculis irregulariter dentatis, dentibus magnis paucis patentibus, vaginis subtruncate rotundatis a lamina bene distinctis.

Of a characteristic small bushy habit. *Internodes* 1 to 3 cm. long, generally unarmed except for one or two spines often present just beneath the nodes. *Leaves* with large, truncately-rounded sheaths, which are entire or with a small tooth on the shoulder; blade at a marked angle with the sheath, thick and fleshy when moistened, 7 to 10 mm.

long, 1 to 2 mm. broad, bearing 2 or 3 lateral teeth, 1 or 2 dorsal, and a sharp terminal tooth; marginal teeth large, triangular, 1·5 to 2 mm. long, ending in a conspicuous sharp reddish-brown spine. Ovary 2–3-styled.

CHINA—Province of Kianang (*Staunton*, in Herb. Mus. Brit.).

Var. MURICATA, A. Br. ex K. Schum. in Mart. Fl. Bras. iii. pt. 3, 725 (1894) (non Hartmann). (Pl. XXXIX. fig. 12.)

N. muricata, Delile, Fl. Égypte, 281, t. 50. fig. 1; Cham. in Linnæa, iv. 500 (1829); Kunth, Enum. iii. 113 (1841); A. Braun, in Journ. Bot. ii. (1864) 276; Boiss. Fl. Or. v. 27 (1884).

N. major, All.; Trimen, in Journ. Bot. xxvii. (1889) 167; Hook. f. Fl. Brit. Ind. vi. 569 (1893).

Caulinia muricata, Spreng. Syst. i. 20 (1825).

Planta internodiis dense muricatis; foliis linearibus, margine dentibus 7–10 densis patentibus instructis, in dorso et vagina quoque spinosis, dentibus laminæ latitudinem sæpissime excedentibus; fructu minore.

Internodes 1 to 3·5 cm. long, shorter in the Ceylon than in the Egyptian specimens, 1 mm. wide, thickly covered with short spines. *Leaves* 1·2 to 1·8 cm. long, ·5 to 1 mm. broad, bearing 7 to 10 patent triangular teeth on each side, equal to or generally exceeding in length the leaf-width; the back bears 3 to 5 spines, the sheath generally two prominent teeth on the shoulder and (in the Egyptian specimens) often a spine on the back. *Seed* 3·5 mm. long by 2 mm. broad, distinctly marked with small 4–5-polygonal areolæ.

LOWER EGYPT—Damietta (*Sieber*, *Ehrenberg*, *Bové*).

CEYLON—Kalmunai (*Nevill*).

Var. GRACILIS, Morong in Bot. Gaz. x. (1885) 255, et in Mem. Torr. Bot. Club, iii. no. 2 (1893) 59; A. Gray, Man. Bot. [ed. 6] 566 (1890).

Var. *angustissima*, K. Schum. in Mart. Fl. Bras. *l. c.* (founded on the same plant [*Curtiss*, no. 2705] as Morong's variety).

Gracilis, internodiis elongatis; foliis anguste linearibus, margine cum dentibus numerosis patentibus magnis instructo, dorso inermi vel paucidentato; vagina utrinque 1–3-dentata; fructu minore.

Internodes 5 to 8 cm. long, becoming shorter at the ends of the long slender shoots, rarely with a few spines. *Leaves* generally between 2·5 and 4 cm. long and ·5 to ·7 mm. broad, with 8 to 12 teeth on each margin; teeth ·5 to 1 mm. long, generally equal to or longer than the leaf-width; sheaths with 1 to 3 prominent teeth on each shoulder. *Male flowers* scarcely 3 mm. long. *Fruit* oblong and narrowed at each end, 3·5 mm. long, 1·6 mm. in diameter. Morong describes the seeds as "sculptured with about 25 rows of nearly square or irregularly oblong reticulations"; in the very few which I have seen, this character is evident only about the middle of the seed. The plant when dry is tinged with purple.

FLORIDA—Near Cape Romano (*Curtiss*, no. 2705).

NOTE.—Morong, in describing the leaf, says "15–24 large teeth on the margin" in Bot. Gaz. *l. c.*, "margins" in Mem. Torr. Bot. Club, *l. c.* He probably refers to the number of teeth on both margins taken together. Schumann, however (*l. c.*), says "foliis . . . . 15–24 serraturis utrinque ornatis," but this is probably a slip, as I have seen the Berlin specimen, which conforms to the description given above.

Var. CALIFORNICA, var. nov. (Pl. XXXIX. fig. 15.)

Planta habitu velut suffruticosa; internodiis sparsissime spinosis; foliis linearibus, apicem versus angustatis, dentibus marginalibus numerosis laminæ latitudinem sæpe haud æquantibus, sæpe excedentibus, spinis dorsalibus sæpe in nervo mediano prominente continuis; vagina dentibus conspicuis 1–3 in parte superiore instructa.

Of a short bushy habit. *Internodes* 1 mm. wide. *Leaves* 1·8 to 2 cm. long, of variable width (about 1 mm.), with 6 to 11, generally about 9 teeth, often upwardly subfalcate, on each margin, the length of which in proportion to the leaf-width is very variable, being perhaps generally greater, but often less or equal. The 4 to 6 dorsal spines are often united at the base, forming a narrowly winged spine-bearing midrib. The single specimen seen is female, with a 3-styled ovary. Fruit absent.

CALIFORNIA—(*Orcutt*; *Coulter*, no. 188).

Var. MEXICANA, var. nov. (Pl. XXXIX. fig. 30.)

Atroviridis, internodiis muricatis, foliis brevibus latis curvatis irregulariter grosse-dentatis, dentibus triangulis patentibus, vagina lata dentibus 1–2 magnis instructa; semine subovoideo areolis parvis plurangulis notato.

Internodes 1 to 2 mm. broad. *Leaves* 1·3 to 1·6 cm. long, 3 to 3·75 mm. broad, including the large close-set teeth, generally with 3 prominent spines on the back. *Fruit* subovoidly-oblong, 3 mm. long by 2 mm. broad. *Seed* with small but fairly distinct polygonal markings.

MEXICO—Muleje (*Palmer*, no. 20).

Well characterized by the short, broad, irregularly cut, curving leaves.

Subgenus 2. CAULINIA, A. Br. (As genus, Willd.)

Monoica; testa e stratis cellularum induratarum tribus constructa.

Generally more delicate plants, with less tissue-differentiation than in *Eunajas*, the epidermis not differing in appearance from the outer layer of the cortex; cortex of stem less developed. Leaves, except at the midrib, only two cell-layers thick. Internodes unarmed. Leaf-margin very variously toothed, spines almost invariably absent from the back.

§ 1. *Spathaceæ.*—Male and female flowers in a spathe.
  Seed straight.
    Leaf-teeth equal in length to leaf-width or greater . . . . *N. indica*, 2.
    Leaf-teeth about half the leaf-width.
      Sheaths with short obtuse auricles . . . . *N. Schweinfurthii*, 3.
      Sheaths truncate or rounded . . . . *N. Welwitschii*, 4.
    Leaf-teeth few and minute . . . . *N. madagascariensis*, 5.
  Seed curved . . . . *N. ancistrocarpa*, 6.
§ 2. *Americanæ.*—Male flowers only in a spathe. Leaf-sheaths sloping.
  Anther unilocular.
    Seed smooth . . . . *N. flexilis*, 7.
    Seed rough . . . . *N. podostemon*, 8.

Anther quadrilocular.
Leaf-teeth minute . . . . *N. microdon*, 9.
Leaf-teeth evident.
Leaves broad (more than 1 mm.) . . . . *N. punctata*, 10.
Leaves narrow (less than 1 mm.)
Seed minute (about 1 mm. long), ellipsoid.
Testa with about 10 rows of areolæ . . . . *N. microcarpa*, 11.
Testa with about 20 rows of areolæ . . . . . *N. Wrightiana*, 12.
Seed long (2 mm. or more) and narrow.
Leaf-teeth few and irregular . . . . *N. conferta*, 13.
Leaf-teeth numerous and regular . . . . . *N. arguta*, 14.
§ 3. *Euvaginatæ.*—Male flowers only in a spathe. Sheaths truncate or more or less auricled.
Anther unilocular.
Areolæ on testa broader than long . . . . *N. minor*, 15.
Areolæ on testa isodiametric . . . . *N. Kurziana*, 16.
Areolæ on testa longer than broad.
Sheaths rounded, scarcely auricled . . . . *N. tenuissima*, 17.
Sheaths with short broad auricles . . . . *N. gracillima*, 18.
Anther quadrilocular (where known).
Asiatic species.
Leaf-sheaths large, with broadly overlapping edges . . . . *N. Kingii*, 19.
Leaf-sheaths more or less cylindrical.
Beak of spathe lacerated . . . . *N. lacerata*, 20.
Beak of spathe not lacerated.
Seed more than 2 mm. long . . . . *N. foveolata*, 21.
Seed about 2 mm. long . . . . *N. falciculata*, 22.
Seed 1 mm. long . . . . *N. brevistyla*, 23.
Australian species.
Leaf-teeth minute.
Sheaths with long auricles . . . . *N. tenuifolia*, 24.
Sheaths with short broad auricles . . . . *N. Browniana*, 25.
Leaf-teeth prominent . . . . *N. Leichhardtii*, 26.
Mascarene species.
Leaves narrow-linear . . . . *N. australis*, 27.
Leaves setaceous . . . . *N. setacea*, 28.
African species.
Leaves falcate, teeth exceeding leaf-width . . . . *N. horrida*, 29.
Leaves not falcate, teeth not exceeding leaf-width . . . . . *N. interrupta*, 30.
§ 4. *Nudæ.*—Male and female flowers without a spathe . . . . *N. graminea*, 31.

§ 1. *Spathaceæ.*

2. Najas indica, Cham. (Pl. XXXIX. figs. 31–45.)

N. indica, Cham. in Linnæa, iv. (1829) 501 (excluding synonymy); Kunth, Enum. iii. 113 (1841); Hassk. Pl. Javan. Rar. 142 (1848).
? *N. indica*, Griff. ex Voigt, Hort. Suburb. Calc. 694 (1845).
N. minor var. *indica*, A. Br. in Journ. Bot. ii. (1864) 278, in part.
N. tenuis, A. Br. ex Magnus, Beitr. p. vii (1870).

Caulinia indica, Willd. in Mém. Acad. Roy. Sc. Berl. 1798, 89, t. 1. fig. 3, et Sp. Pl. iv. 182 (1805); Spreng. Syst. i. 20 (1825).
Fluvialis indica, Pers. Syn. ii. 530 (1807).

Laxa, caulibus tenuissimis, sæpe filiformibus; *foliis* angustissime linearibus, superne attenuatis, sæpe setaceis, apice sæpe bispinulato, margine valde dentato, dentibus triangulis patentibus vel ascendentibus, laminæ latitudinem sæpius æquantibus vel superantibus; *vaginis* angustis, in auriculas fimbriatas productis, vel subtruncatis, vel late rotundatis et conspicue paucidentatis; squamulis intravaginalibus anguste subulatis vel e basi latiore acuminatis; *floribus* solitariis subsessilibus, spatha mascula ellipsoidea in collum tenue cum ore irregulariter dentato et utrinque processu lineari spinifero instructo, superne angustata; anthera quadriloculari; spatha feminea anguste ellipsoidea cum collo breviter cylindrico et ore spinifero, ovario spathæ conformi, stylo brevi a stigmatibus duobus inæqualibus terminato; *fructu* parvo ellipsoideo spatha persistente incluso; *semine* pericarpio conformi, testa cum areolis quadratis minutis numerosis lineata.

Leaves 2 to 3 cm. long by scarcely ·5 mm. broad; margin with 10 to 17 large teeth, often as long as, or longer than, the leaf-width, and consisting of subequilateral or obtusely triangular projections of the margin ending in a spine. Sheath narrow, 2·5 to 4 mm. long; form of upper margin variable: the original specimen (*Caulinia indica*, Willd.! in Herb. Berlin) markedly auricled, the auricles breaking up into a few one- to several-toothed portions; in other cases almost truncate or even broadly rounded, the shoulder bearing a few (4 to 6) prominent teeth. On the same shoot may be found almost truncate sheaths, and others with well-marked auricles.

Male flowers 3·75 mm. long, spathe narrowed above into a slender neck ending in an irregularly toothed mouth, which is generally drawn out into two opposite long linear prolongations ending in one or two spines; perianth fitting closely to the ellipsoidal anther and meeting above its apex in two thickened lips. Dehiscence occurs by elongation of the flower-stalk inside the spathe, which becomes laterally split above, the anther, still enveloped by the perianth, becoming raised on a long slender stalk, equal to its own length; the lips of the perianth become reflexed and the anther dehisces at the top. Pollen-grains somewhat irregularly shaped, and often hexagonal after dehiscence. *Female flowers* 3 to 3·25 mm. long, spathe passing above into a neck about $\frac{1}{4}$ to $\frac{1}{3}$ its whole length, the mouth bearing short brown spines; the short cylindrical style ends in two unequal stigmas, one of which is seen protruding through the perianth.

Fruit 2 mm. long. *Seed* yellow or brown, with 25 to 30 rows of well-marked fairly isodiametrical quadrate areolæ, which rapidly become narrower on and near the raphe.

INDIA—Bengal, Behar (*Hook. f. & Thomson*), Jynuggur (*Clarke*, no. 7540); Tranquebar (*Klein* in Herb. Willd. no. 17092), (Soc. Unit. Fratr. 1778, in Herb. Mus. Brit.).

3. NAJAS SCHWEINFURTHII, Magnus in Ber. Deutsch. Bot. Ges. xii. (1894) 220. (Pl. XL. figs. 64–67.)

Planta ut videtur parva, caulibus filiformibus, ramulis ultimis dense foliatis; *foliis* lineari-angustatis graciliter subrecurvatis, margine dentibus ascendentibus sub-

prominentibus frequentius instructo; *vagina* cylindrica breviter auriculata, auriculis obtusis irregulariter spinosis; *floribus* solitariis, *masculis* breviter pedicellatis, spatha oblonga superne in collum late cylindricum ore irregulariter denticulatum transiente; anthera uniloculari; *femineis* subsessilibus spatha anguste ovali-oblonga cum collo cylindrico, ore pauci-spinifero, stylo in stigmata duo diviso; fructu et semine . . . .

Judging only from the fragmentary specimens (which were mixed with *N. graminea*), a small plant with spreading branches. *Leaves* thin, slender, tapering, 1·4 to 2·1 cm. long by ·4 mm. broad (without the teeth); marginal teeth about a dozen, subtriangular, ending in an upwardly-pointing brown spine, in length about half the leaf-width; apex ending in one or a pair of spines. *Sheath* 2 to 3 mm. long; auricles with 3 to 4 erect teeth.

Male flowers about 2 mm. long before dehiscence of the anther, spathe below its neck fitting closely to the perianth, which has a markedly bilabiate top above the anther. On dehiscence the spathe splits from above downward and the anther is carried up on a long stalk, the whole flower measuring 3·5 mm. long.

Female flowers very shortly stalked, about 2·25 mm. long, the spathe conforming to the ovary below, and produced into a neck surrounding the long style, which ends in two short unequal stigmas protruding beyond the mouth. The specimens bear no ripe fruit.

Tropical Africa—Grosse Seriba Ghattas, Djur-land (*Schweinfurth*, no. 2140 in part). (Mixed with *N. graminea.*)

Near *N. Welwitschii*, but distinguished by its narrower auricled sheaths and smaller male flowers.

4. Najas Welwitschii, Rendle. (Pl. XXXIX. figs. 46–52; Pl. XL. figs. 53, 54.)

N. Welwitschii, Rendle, in Welw. Cat. ii. 95 (1899).

Najas sp., Magnus, Beitr. 44, 45, t. 5. fig. 18 (1870).

Herba læte viridis, lucidula, caulibus ramisque effusis; *foliis* planis lineari-angustatis, in vivo patentibus, margine dentibus frequentibus ascendentibus subprominentibus instructo; *vaginis* late rotundatis vel truncatis, cum denticulis numerosis superne marginatis, sæpe asymmetricis; squamulis intravaginalibus subulatis; *floribus* solitariis, spatha mascula ellipsoidea, cum collo breviter cylindrico, ore spinifero; anthera quadriloculari; spatha feminea ut in mari, sed cum collo longiore (? bilabiato), stylum et stigmata duo celante; *fructu* spatha incluso, demum a semine maturo ellipsoideo-oblongo, apice angustato, rupto; *testa* cum areolis quadratis distinctis numerosis lineata, raphei prominente.

"Swimming at the bottom of water, usually in not very deep water, rooting in the mud by a long root-fibre-bearing rhizome."

Shoots spreading, rooting copiously at the nodes, the longest 30 cm., branches spreading; lower internodes reaching 4 to 5 cm. in length by 1 mm. in width, becoming gradually smaller on the branches, the upper being about 1 cm. long by ·5 mm. in width. Branchlets and leaves in the dried specimens limp and flaccid, hanging together; but the leaves are described as spreading in the living state. *Leaf-blades* generally 2 to 2·5 cm. long by ·4 to ·5 mm. in greatest width above the sheath, with an evident midrib and, on the older leaves, transverse markings, especially in the lower part; marginal teeth, generally 12 to 16, broadly subtriangular, ending in an ascending brown spine: in the

middle of the blade they are about half the leaf-width in length; leaf apex 1- to 2-spinulate. *Sheaths* 2 to 3 mm. long and nearly or quite as broad: their truncate upper margin or rounded shoulders bear 5 to 9 small erect teeth, tipped with yellowish spinules. Intravaginal scales a little over 1 mm. long.

Male flowers subsessile, 3 mm. long, mouth of the short beak of the spathe oblique and tipped with sharp yellowish-brown spines; one, in which elongation of the pedicel had taken place, was 4·5 mm. long, the narrowly ovate anther with its closely-fitting perianth measuring 2·5 mm.; pollen-grains roundish.

Female flowers 2·2 mm. long; spathe closely resembling that of the male, but with a much longer neck, nearly as long as the lower portion.

Seed 2·5 mm. long by about $\frac{2}{3}$ mm. in diameter, very pale brown, with about 25 rows of distinct quadrilateral markings.

TROPICAL AFRICA—Angola, Barra do Bengo, in a large lake near Quifandongo (*Welwitsch*, no. 247), and Barra do Dande, lakes on left of the river Dande, near Bombo (*Welwitsch*, no. 247 *b*).

5. NAJAS MADAGASCARIENSIS, sp. nov. (Pl. XL. figs. 55–63.)

Laxissima, caulibus et foliis elongatis, his angustissimis, in ramis juvenilibus filiformibus, margine superne solum minute et sparse denticulato; *vaginis* anguste cylindricis oblique vel vix auriculatis, vel rotundatis, sparse denticulatis; squamulis intravaginalibus filiformibus; *floribus* solitariis, masculis breviter pedicellatis, spatha anguste ovoidea cum collo cylindrico, apice aculeifero bifido; anthera quadriloculari; femineis sessilibus, ovario ellipsoideo a spatha cum collo cylindrico, ore spinifero, circumdato; *fructu* anguste ellipsoideo sub apice angustato, a spatha persistente vestito, pericarpio semini conformi et areolas testæ quadratas vel sexangulares in seriebus numerosis ordinatas monstrante.

The habit is extremely lax, the whole plant being limp and falling into a tangled thread-like mass when removed from the water. Shoots 30 cm. long were measured, and greater lengths are probably reached. Lower internodes reaching 7 cm. in length, and nearly 1 mm. broad, upper shorter, 2·5 to 1 cm. long just below the top, and about $\frac{1}{3}$ mm. broad. *Leaves* to 4·5 cm. long by ·4 mm. broad below, tapering gradually upward to the very fine bispinulate apex. *Sheaths* 3 to 5 mm. long by about one-third as broad, asymmetrically auricled, with a few (4) small teeth on the upper margin, or with slightly raised or sloping shoulders with 4–6 or more small teeth. To the naked eye the leaf-margin seems untoothed; a lens discloses a few (about 5) teeth in the upper third, the remainder being entire. Teeth consisting of a sharp ascending brown spine on a slight elevation of the margin. Intravaginal scales a little over 1 mm. long. Male and female flowers on the same shoot.

Male flowers to 4 mm. long, neck of spathe nearly 1 mm. long, shortly bifid at the top, where it bears a few sharp brown spines; perianth fitting closely to the anther, and meeting in two thickened lips above its apex.

Female flowers about 3 mm. long; ovary closely enveloped by the spathe; neck of spathe, about 1 mm. long, surrounding the two stigmas.

Fruit beaked with the neck of the persistent spathe and the remains of the styles; 2·5 to 3 mm. long without the beak, by ·7 mm. in diameter. Spathe very thin and membranous, and easily peeled off, exposing the pericarp, which clings closely to the seed and shows about 25 regular rows of squarish or hexagonal markings.

MADAGASCAR—(*Hildebrandt*, no. 4027; *Baron*, nos. 3339, 3419).

6. NAJAS ANCISTROCARPA, A. Br. ex Magn. Beitr. pp. vii and 24, t. 3. figs. 1–5 (1870).

Planta caulibus dichotome ramosis; *foliis* recurvatis, iis *N. minoris* similibus, sed minus robustis et angustioribus; *vaginis* truncatis vel rotundatis; *flore masculo* a spatha ellipsoidea cum collo breviter cylindrico, ore spinifero, vestito; perianthio ad antheram quadrilocularem arcte applicito; *fructu* parvo tenui falcato a spatha persistente incluso, in curvo interiore carinato, pericarpio longitudinaliter striato.

Leaves 1·5–2 cm. long, generally ·25–·35 mm. broad, with about 15 teeth on each side; sheaths with about 5 teeth. *Fruit* very narrow, curved towards the axis into a semicircle, much smaller than in *N. minor*, protruding from the sheath. Pericarp clinging closely to the testa and marked out by fine longitudinal and faint transverse lines into regular rows of areas about twice as long as broad.

JAPAN—Yokohama (*Wichura*, no. 813, in part).

A very imperfectly known species.

§ 2. *Americanæ.*

7. NAJAS FLEXILIS, Rostk. & Schmidt. (Pl. XL. figs. 92–98.)

N. flexilis, Rostk. & Schmidt, Fl. Sedin. 382 (1824); Cham. in Linnæa, iv. (1829) 501; Kunth, Enum. iii. 114 (1841); A. Br. in Journ. Bot. ii. (1864) 276; Phytol. iii. (1850) 1088; Sadler in Journ. Bot. xiii. (1875) 297; Garcke, Illustr. Fl. Deutschl. 566 (1895); Fries in Bot. Notis. 1850, 227; Nilss. in Bot. Notis. 1881, 137; G. Anderss. Svensk. Växtvärld. Hist. 41, t. 32 (1896), & in Engl. Bot. Jahrb. xxii. (1896) 467, t. 4. fig. 14; C. A. Weber in Abh. Naturw. Ver. Brem. xiii. (1896) 434, &c.; A. Gray, Man. Bot. [ed. 6] 566 (1890); Macoun, Cat. Canad. Pl. ii. 91 (1888), & in Canad. Rec. Sci. 1895, 276; Morong in Bot. Gaz. x. (1885) 255, et in Mem. Torr. Bot. Club, iii. (1893) no. 2, 59, t. 66; S. Watson, in Geol. Surv. Calif. (Bot.) ii. 191 (1880); Jönsson in Act. Univ. Lund. xx. (1883–4) t. 1; Britton & A. Brown, Ill. Fl. North. U. S. i. 81, fig. 180 (1896).

N. graminea, Rostk. ex Link, Handb. i. 287 (1829), non Delile.

N. canadensis, Michx. Fl. Bor. Am. ii. 220 (1803); Pursh, Fl. Am. Sept. 602 (1814); Cham. in Linnæa, iv. (1829) 502; Kunth, Enum. iii. 115 (1841).

Caulinia flexilis, Willd. in Mém. Acad. Roy. Sci. Berl. 1798, 89, t. i. fig. 1, et Sp. Pl. iv. 183 (1805); Pursh, *l. c.*

C. fragilis, Pursh, *l. c.*, non Willd., probably refers to this species.

Fluvialis flexilis, Pers. Syn. ii. 530 (1807).

Erecta vel suberecta, internodiis tenuibus rigidulis, ramis erectis vel ascendentibus, apice sæpe plumosis; *foliis* patentibus sæpe graciliter recurvatis, anguste linearibus, apicem versus sæpe angustatis, acutis vel acutiusculis, marginibus sæpe incurvatis spinulis minutis numerosis ascendentibus instructis; *vaginis* superne cum dentibus paucis subprominentibus munitis; squamulis intravaginalibus filiformibus, interdum basi latioribus, vel lanceolatis; *floribus* solitariis, masculis sub apice ramulorum fertilium paucis breviter pedicellatis, spatha oblonga, interdum ovali-oblonga, superne

in collum spiniferum transeunte; anthera uniloculari tandem in pedicello longo spatham oblique præruptam excedente; polline oblongo; ovario nudo oblongo, stylo stigmatibus geminis cum processubus spiniferis binis instructo; *fructu* parvo oblongo, pericarpio ad semen leve conformante; *testa* polita, areas autem plus minus sexangulares parvas numerosas permonstrante.

Slender and graceful in habit, often plumose from the short, spreading, densely-leaved tufts of branchlets, which in the low-growing forms conduce to a bushy growth. *Leaves* 1 to 2·5 cm. long, generally about ⅔ mm. broad, with 20 to 36 teeth on each margin and 6 to 13 on the sloping shoulder of the sheath; margin strengthened by a layer of narrow elongated hypodermal cells. Intravaginal scales filiform, sometimes broader at the base, sometimes lanceolate, ⅔ mm. long. Fertile branches protogynous, a few male flowers appearing just beneath the apex, while in the lower leaf-axils all stages can be found between young female flowers and ripe fruit.

Male flowers 2·5 to 3·25 mm. long; stalk elongating before dehiscence, and pushing the anther, enveloped by the perianth, through the laterally split spathe.

Female flowers about 2·5 mm. long. *Fruit* 2·5 to 3 mm.

North-west Europe—Scotland (Loch Clunie, Perth); Ireland (Connemara, *Oliver* and others: Killarney, *More* and others); North Germany (Binow-See: Parstein-See); Apland (Lake Hederen, *Fries*); Finland (Lake Wesijärvi). Recorded fossil from recent beds in Hanover, Holstein, S.W. Norway, Sweden, and East Finland.

North America—Generally distributed in Canada and the Northern United States. I have seen specimens from Canada (*Macoun*, nos. 1437, 4803), (*Cleghorn*); British Columbia (*Macoun*); Minnesota; Philadelphia (*Nuttall*); New York (*Torrey*); Boston; Maine (*Fernald*, no. 119); Washington; Iowa (*Morong*); Missouri (*Mackenzie*, no. 792); New England (*Curtiss*); New Hampshire (*Engelmann*); Cincinnati (*Clark*); Oregon (*Lyall*).

Var. microcarpa, Nilss. in Bot. Notis. 1881, 147; Hartm. Handb. Skand. Fl. (ed. 12) 62 (1889).

Planta brunneo-viridis, fructu minore.

Distinguished by its small fruit, which is only 2 to 2·25 mm. long. Perhaps only a small-fruited form of the type.

Sweden—Lake Ringsjön (*Nilsson*, and in Schultz, Herb. Norm. no. 1878).

Var. robusta, Morong in Bot. Gaz. x. (1885) 255, et in Mem. Torr. Bot. Club, iii. no. 2, (1893) 60; A. Gray, Man. Bot. [ed. 6] 566 (1890).

Planta caule robusto, elongato, sparse ramoso et paucifoliato; foliis linearibus, planis, abrupte acutis.

Leaves 10 to 15 mm. long, 1·5 to 2 mm. broad.

"Found rising to the surface in still ponds, in water 4 to 6 ft. deep. Sterile plants only seen."

North America—East Massachusetts; Michigan; Texas (*Wright*). Not seen. Perhaps a form of *N. microdon*.

Najas flexilis is a temperate species which, judging from the increasing number of localities for its fossil fruits in Northern Europe, was formerly more widely spread than at present over the cooler parts of the north temperate zone. It is represented in the warmer parts of America by *N. microdon*, which spreads from the southern United States through Central America and the West Indies into South America, and as far south as Uruguay. The two species are very similar in vegetative characters, but can be certainly distinguished by the fruit, that of *N. flexilis* presenting a polished appearance to the naked eye, while that of *N. microdon* shows an evident sculpturing. *N. flexilis* has generally a stiffer habit and often a bushy growth, with generally narrower recurving leaves.

Morong (in Mem. Torr. Bot. Club, iii. no. 2, 59) states that *N. flexilis* is diœcious, but this is not so. The male flowers seem to be produced in fewer numbers than the female.

8. NAJAS PODOSTEMON, Magn. Beitr. p. vii, t. 3. fig. 15, t. 5. figs. 16, 17 (1870), & in Ber. Deutsch. Bot. Ges. xii. (1894) 20; K. Schum. in Mart. Fl. Bras. iii. pt. 3, 730, t. 123, fig. 3 (1894).

Planta effusa caulibus elongatis gracillimis flexibilibus rhombeo-dichotome ramosis; internodiis inferne elongatis denudatis superne abbreviatis habitum confertum præbentibus; *foliis* anguste linearibus attenuato-acuminatis flexibilibus interdum recurvatis, membranaceis, manifeste serratis, dentibus cum cellulis pluribus marginem superantibus, subrepandis; *vagina* declivi tenera dentibus 2–3 vel interdum 4 plus minus productis instructa; squamulis intravaginalibus lineari-subulatis; *flore masculino* manifeste et longiuscule pedicellato, spatha superne in collum angustum ore spiniferum producta; perianthio apice bilabiato ad antheram uniloculairem arcte applicito; *flore femineo* nudo lageniformi, stylo in stigmata 2–3 tantum diviso; *fructu* subfusiformi, semine parvo graciliter tessellato, cum seriebus arearum subelongatarum numerosis exsculpto.

Shoots very long, 30 to 40 cm., or longer, scarcely 1 mm. wide in the lower part. *Leaves* generally 7 to 10 (rarely to 14) mm. long, ·7 to 1 mm. broad including the marginal teeth, teeth reaching ·3 mm., the lowest larger and more remote, generally about 10 each side, sometimes fewer, rarely as many as 20. *Sheath* 1 to 1·5 mm. long, by 1 mm. or slightly broader at the middle. Intravaginal scales scarcely ·5 mm. long. *Male flower* 1·5 to 1·7 mm. long including the pedicel (·5 mm.), neck about ·3 mm., with 3 to 5 brown spine-teeth at the mouth. Magnus states that the flower-stalk proper may become elongated within the spathe before dehiscence, pushing the flower out above the spathe. *Seed* 1·1 to 1·2 (or according to Schumann nearly 1·5) mm. long, about ·5 mm. at its greatest diameter; testa with 25 to 30 rows of rather shallow, somewhat elongated areas.

BRAZIL—Prov. Alto Amazonas, Rio Maranhão (*Pohl*; *Vauthier*).

I am indebted for many of the details in the above description to the descriptions and figures of Magnus (*l. c.*) and K. Schumann (*l. c.*).

9. NAJAS MICRODON, A. Br. (Pl. XL. figs. 78–91.)

N. microdon, A. Br. in Sitzungsb. Ges. Naturf. Fr. Berlin, 1868, 17; Morong in Bot. Gaz. x. (1885) 256. Var. *guadalupensis*, A. Br. *l. c.*

Najas flexilis, Griseb. Veget. Karaib. 110 (1857), non Rostk.
Var. *guadalupensis,* A. Br. in Journ. Bot. ii. (1864) 276.
Var. *fusiformis,* Chapm. Fl. South. U. S. 444 (1860); Morong in Bot. Gaz. x. (1885) 256, & in Bull. Torr. Bot. Club, xiii. (1886) 160.
N. guadalupensis, Morong in Mem. Torr. Bot. Club, iii. no. 2 (1893), 60, t. 67; K. Schum. in Mart. Fl. Bras. iii. pt. 3, 726 (1894), t. 124. fig. 1; Britton & A. Brown, Ill. Fl. North. U. S. i. 81, fig. 181 (1896).
Caulinia guadalupensis, Spreng. Syst. i. 20 (1825).

Monoica, debilis, diffuse ramosa, internodiis tenuibus, interdum subfiliformibus; *foliis* patentibus, interdum flexuosis, planis vel margine plus minusve crispulatis, linearibus, cum apice obtusiusculo vel plus minus acuto, et margine spinulis minutis numerosis ascendentibus instructa; *vaginis* in parte superiore cum dentibus paucis subprominentibus instructis; squamulis intravaginalibus angustis, sæpe e basi latiore filiformibus; *floribus* masculis solitariis, sæpe breviter pedicellatis, spatha ellipsoidea vel ellipsoideo-oblonga cum collo sub ore spinulis acutis instructo; anthera quadriloculari; polline oblongo; femineis solitariis vel geminis vel fasciculatis, ovario nudo oblongo, stylo valido cum stigmatibus sæpe duobus, processubus spiniferis binis superadditis, interdum stigmatibus tribus; *fructu* parvo anguste ellipsoideo vel ellipsoideo-oblongo; semine ruguloso cum areis subquadratis in seriebus longitudinalibus 15–18 manifeste exsculpto.

Habit very variable, depending on the degree of branching, the diameter of the stem, the length and breadth of the leaves, and the flat or more or less crisped character of the leaf-blade.

The long, slender, weak branches bear leaves at fairly regular intervals along their whole length. *Leaves* 1 to 2·5 cm. (often about 1·5) cm. long, by ·4 to 1 mm., often about ·5 or ·75 mm. broad; marginal spine-cells yellow, generally visible only under a lens, from 20 to 45, according to the length of the leaf, sometimes extremely small and blunt, at others longer and sharply pointed. The level of the epidermis is sometimes broken only by the spine, sometimes raised slightly about the insertion of each spine. In a plant from Nicaragua (*Wright*) the spines are sometimes supported on a base of 2 to 3 cells projecting from the epidermis, forming more conspicuous teeth. Leaf-apex with one or a pair of sharp spines. Sheath 1·5 to 2 mm. long and as broad; spines on sloping shoulders 4 to 10, sharply pointed, and borne on a several-celled base. *Male flowers* from 2·3 to 3 mm. long, with a longer or shorter neck, which may reach ·6 mm. in length. *Female flowers* 2·5 to 2·75 mm. long, showing great variety in the number of stigmas and spine-bearing processes. *Fruit* in clusters of 2 to 5, narrow, sometimes oblique, fairly uniform in shape and size; about 2 mm. long; pericarp conforming closely to the seed. The 4- (sometimes 5- or 6-) sided areolæ are very plain in the middle of the seed, becoming smaller and less distinct on the sides and towards the base and apex.

The most general form of female flower has two more or less ligulate stigmas and a pair of longer, slender, spine-tipped processes decussating with them; but there may be 2 stigmas only, or 3 stigmas, or 2 stigmas and 1 spine-arm (a frequent variation), or 1 stigma and 2 spine-arms, or 3 stigmas one of which bears a brown spine-cell, or 2 stigmas and a structure which is part stigma, but drawn out on one side into a narrow spine-arm.

These variations, and especially the occurrence of transitional structures showing both the irregular papilliform surface of a stigma and the uniform ribbon-like character of the spine-arm, indicate that the spine-arms are only barren stigmas.

In still or flowing water.

NORTH AMERICA—Texas (*Hall*, no. 618; *Lindheimer*, no. 705; *Drummond*, no. 436); California, San Francisco (*Adoltz*); West Texas to New Mexico (*Wright*, no. 678); Florida (*Chapman*).

CENTRAL AMERICA—Mexico (*Schaffner*, no. 227; *Hahn*; *Mueller*, Orizaba; *Schiede*, no. 844; *Palmer*, Durango, nos. 157, 704, 708); Guatemala (*Bernouilli*, nos. 206, 818, 1068); Nicaragua (*Wright*; *Tate*, no. 398).

WEST INDIES—Guadeloupe (*Duchassaing*); Cuba (*Wright*, nos. 72, 74, 76, 77; *Combs*, no. 707); Jamaica (*Swartz*); Porto Rico (*Sintenis*, nos. 852, 1060, 2330, 3803).

SOUTH AMERICA—Caracas (*Ernst*, no. 4, "in rivulo Caroate"); Uruguay, Rio Fernandez (*Niederlein*, no. 214); Argentina (*Hieronymus*, no. 553, "Laguna del Palmar cerca de San José, Oran": no. 745, "Lagunas de Bajo del Manzano, Provincia de Cordoba").

Var. CURASSAVICA, A. Br. in Sitzungsb. Ges. Naturf. Fr. Berlin, 1868, 17, extensa.

N. flexilis varr. *curassavica* et *Gollmeriana*, A. Br. in Journ. Bot. ii. (1864) 277.

Planta robustior, suberecta, minus et rarius diffuse ramosa; foliis latioribus sæpissime planis.

A stronger growing plant, 10 to 20 cm. high, the specimen from Florida (*Rugel*) alone having the weakly habit and markedly crispulate leaves of the type. *Leaves* 1·2 to 2·7 cm. long, generally about 2·0 cm., 1 to 1·75 mm. broad, generally about 1·5 mm., with 30 to 50 teeth on the margins.

NORTH AMERICA—Florida (*Ruegel*).

CENTRAL AMERICA—Mexico (*Schaffner*; *Hahn*).

WEST INDIES—Porto Rico (*Sintenis*, no. 2533); Cuba (*Wright*, 605 in Herb. Kew.).

SOUTH AMERICA—Caracas (*Seemann*; *Gollmer*; *Ernst*, Najades, nos. 1, 2, 5, 1765 *a*); (*Spruce*, no. 6456).

It is difficult to draw a hard-and-fast line between the variety and the species, though most specimens can easily be relegated to one or the other.

10. NAJAS PUNCTATA, sp. nov. (Pl. XL. figs. 99–102.)

N. flexilis var. *punctata*, A. Br. in Journ. Bot. ii. (1864) 277.

Planta caulibus rigidis, ramis brevibus; *foliis* subascendentibus, rigidulis, punctatis, late linearibus, superne angustatis, nervo centrali conspicuo, spinis marginalibus magnis cum cellulis binis super marginem elevatis basi munitis; *vaginis* validis in laminam gradatim transgredientibus, squamulis intravaginalibus lanceolatis; *floribus* solitariis, masculis *N. microdontis*, femineis cum stigmatibus binis, processu spinifero interdum superaddito; fructu . . . . . .

The straight stiff stems, with their short branches, afford a characteristic habit. *Leaves* tough and strong, about 1·8 cm. long and 1·5 mm. broad; sheath 2·8 mm. broad, with

about 10 teeth on its sloping shoulders; blade tapering gradually upward or near the top only; the stiff brown ascending spines, about 35, are slightly raised above the margin, which is strengthened with several hypodermal rows of elongated narrow cells. Intravaginal scales 1 mm. long.

The brown spots which give the leaves their characteristic punctate appearance are due to the presence of scattered tannin-sacs.

Male flowers 3 mm. long, borne on a short pedicel; *female flowers* 2 mm.

SOUTH AMERICA—Caracas, Udora Valencia (*Gollmer*).

11. NAJAS MICROCARPA, K. Schum. in Mart. Fl. Bras. iii. pt. 3, 727 (1894).

"Caulibus exemplarium exstantium apicem tantum referentium internodiis valde abbreviatis, ita ut habitus confertus evadat, ramosissimis, rhombeo-dichotomis; *foliis* patentibus subflexilibus, haud curvatis, anguste linearibus acuminatis, cellulis scleroticis marginalibus et dorsalibus 0, jam oculo nudo manifeste serratis, serraturis subrepandis 7–10 utraque laminæ parte, cellulis pluribus ultra marginem laminæ elevatis; *vagina* declivi serraturis 3–5 utroque latere interdum tali modo ultra marginem elevatis ut vagina subciliata evadat; *flore femineo* lageniformi, apice in ramos stigmatiferos binos, insuper in aculeiferos solitarios vel binos, rarius ternos, desinente; *flore masculino* . . . . . ; *semine* ellipsoideo utrinque obtuso in genere minimo, seriebus arearum majuscularum exsculpto, cellulis epidermidis in parietibus lateralibus gracillime systemate duplici linearum reticulatis."

Specimens only 2 to 3 cm. long, with internodes not exceeding 5 mm. long and about ·3 mm. wide. *Leaves* reaching 1 to 1·2 cm. long, and, including the teeth, scarcely ·5 mm. broad, dull blackish green or black. *Sheaths* reaching 1 to 1·2 mm. long, and 1·2 to 1·5 mm. broad; intravaginal scales scarcely exceeding ·5 mm. *Female flowers* generally closely crowded in threes in the leaf-axils (as in *N. graminea*), 1·5 mm. long, style scarcely half the length. *Seed* yellow, less than 1 mm. long and half as thick, with about 10 rows of proportionately large pits, scarcely more than 8 in a row.

PARAGUAY—(*Weddell*, nos. 2374, in part, and 3289).

Plant not seen. The description is copied from Schumann (*l. c.*), who says that the species comes near *N. microdon* and *N. conferta* in the structure of the seed-coat, but differs from them and all others known in its very small, broadly ellipsoidal seeds, twice as long as broad. The very narrow leaves and more or less ciliated sheath also afford distinctive characters.

12. NAJAS WRIGHTIANA, A. Br. (Pl. XL. figs. 68–74.)

N. Wrightiana, A. Br. in Sitzungsb. Ges. Naturf. Fr. Berlin, 1868, 17; K. Schum. in Mart. Fl. Bras. iii. pt. 3, t. 123. fig. 1 (sub *N. conferta*).

N. flexilis, Griseb. Cat. Pl. Cub. 218 (1866), non Rostk.; A. Br. *l. c.*

Erecta, caule interdum quoque ramis primariis validis, ramis vel ramulis brevibus dense foliatis; *foliis* tenuibus anguste linearibus obtusis vel subacutis, patentibus, leviter recurvatis, margine denticulato, denticulis patentibus a spinulis ascendentibus terminatis; vaginis cum dentibus paucis prominulis instructis; squamulis intravaginalibus brevibus anguste lineari-lanceolatis, sublanceolatis, vel oblongis, et sub apice angus-

tatis; *floribus* masculis solitariis, breviter pedicellatis, spatha ellipsoideo-oblonga in collum apice paucispiniferum desinente; anthera quadriloculari; *femineis* aggregatis nudis, ovario subovoideo, stylo in stigmata bina partito; *fructu* parvo subellipsoideo, semine ruguloso cum areolis subquadratis in ordinibus circa 20 lineato.

The largest specimen, an incomplete shoot, has an almost straight stem 40 cm. high and 1 mm. in diameter; internodes very regular, about 2·5 cm. long, becoming shorter (2 cm.) near the apex. The short stiff ascending lateral branches increase in length regularly upward from 1 cm. to 4 cm., decreasing again somewhat towards the apex; the branches or their short ascending branchlets are densely leaved; the spreading, slightly recurved leaves give a plumose appearance to the whole. *Leaves* 1 2 to 2·2 cm. long, ·4–·5 mm. broad, not including the teeth, which project about half the leaf-width from the margin, and number between 15 and 20 on each side; apex ending in a single spine; sheaths 2 to 3 cm. long and about as broad, the sloping shoulders of each with 5 to 7 rather prominent teeth.

Male flowers 2 mm. long. *Fruit* little more than 1 mm.

West Indies—Cuba (*Wright*, nos. 78, 605, 3716, pars in Herb. Krug et Urban).

Brazil—Pernambuco (*Schenck*, no. 4161; *Ridley*).

Var. laxa, A. Br. in Sitzungsb. Ges. Naturf. Fr. Berlin, 1868, 17.

Planta debilis et laxa, foliis quam in typo latioribus, cum dentibus marginalibus ascendentibus et minus prominulis, apice acuminato, vaginæ dentibus paucis et parvis.

Differs considerably in habit from the type, but the flowers are exactly the same.

West Indies—Cuba (*Wright*, nos. 73, 3716, pars altera in Herb. Krug et Urban).

13. Najas conferta, A. Br. (Pl. XL. figs. 75–77.)

N. conferta, A. Br. in Sitzungsb. Ges. Naturf. Fr. Berlin, 1868, 17; Magn. Beitr. 47 &c. (1870); K. Schum. in Mart. Fl. Bras. iii. pt. 3, 728 (1894), in part.

N. arguta var. *conferta*, A. Br. in Journ. Bot. ii. (1864) 277.

Herba minor? confertim ramosa et dense foliata; *foliis* anguste linearibus subobtusis, margine valde denticulato, denticulis vix numerosis ascendentibus vel patentibus laminæ latitudinem excedentibus; *vaginis* cum denticulis paucis vix prominulis instructis; squamulis intravaginalibus e basi anguste lineari filiformibus; *floribus* . . . . . . ; *fructu* anguste ellipsoideo-oblongo, ad semen conformante, testa cum seriebus arearum angustarum quadrilateralium numerosis longitudinaliter at obscurius exsculpta, pallide flavescente-brunnea.

Apparently a small plant, characterized by bushy growth and very thick foliage. *Leaves* 1·2 to 1·7 cm. long, about ·5 mm. broad, with 8 to 10 large, irregular, acutely triangular, patent teeth on each margin. I could find no flowers on the specimens which in my opinion belong to this species. *Seed* narrow, 2 mm. long by ·4 mm. in diameter, slightly narrower at the apex than at the base, obscurely marked with numerous rows of narrow drawn-out recesses.

West Indies—Cuba (*Wright*, nos. 75, 3715).

Brazil—(*Max von Neuwied*) ? Rio Tocantin (*Weddell*, no. 2374, in part).

Insufficiently known, but apparently near *Najas Wrightiana*, to which, I think, belong some of the specimens assigned to *N. conferta* by Schumann. It is distinguished by its narrower, shorter leaves, with larger, fewer, and less symmetrical teeth, and longer narrow fruit.

14. NAJAS ARGUTA, H. B. K. (Pl. XL. figs. 103, 104.)

N. arguta, H. B. K. Nov. Gen. & Sp. Pl. i. 371 (1815); Kunth, Enum. iii. 113 (1841); A. Br. in Journ. Bot. ii. (1864) 277; Magnus, Beitr. p. vi, &c. t. 3. figs. 19–22; K. Schum. in Mart. Fl. Bras. iii. pt. 3, 729 (1894).

Var. *tenera*, A. Br. *l. c.*

N. tenera, Schrad. in Gött. Gelehrt. Anzeig. ii. (1821) 715.

Caulinia tenella, C. G. Nees in Neuwied, Reise Bras. ii. 345 (1824).

"Læte viridis," caulibus gracilibus, sæpe filiformibus, dichotome et diffuse ramosis, ramulis ultimis plumosis condensatis; *foliis* latiuscule linearibus obtusis vel obtusiusculis laxiter recurvatis, lamina juxta nervum medianum conspicue tessellata plana, margine cum denticulis frequentibus sat conspicuis regulariter munito; *vagina* late rotundata prominule et regulariter denticulata; squamulis intravaginalibus anguste linearibus, subacutis; *floribus* masculis cum spatha ellipsoidea sub apice in collum breve ore spiniferum desinente; anthera quadriloculari; ovario nudo lageniformi superne in stigmata bina et processus 2–3 aculeiferos desinente; "*semine* elongato-fusiformi, pro rata tenui, utrinque acuminato, seriebus arearum elongatarum plurimis exsculpto."

Apparently a small plant, with a much branched, densely dichotomous plumose habit. *Leaves* about 2 cm. long by 1·25 to 1·5 mm. broad; margin shallowly dentate, teeth patent, about 20 each side, $\frac{1}{3}$ to $\frac{1}{4}$ the leaf-width, consisting of a several-celled triangular outgrowth ending in a spine-cell. *Sheath* 4·5 mm. long, by 4 mm. broad when opened out, the broad sloping shoulders shallowly denticulate, the teeth (about 10) becoming smaller down the sides, along which they run for about halfway to the base. Intravaginal scales about ·6 mm. long. *Male flower* about 1·75 mm. long, the short neck about $\frac{1}{5}$ the length of the whole. Ovary ending irregularly in a pair of stigmas and 2 to 3 spine-arms. *Seed* not seen, but according to K. Schumann (in Mart. Fl. Bras. *l. c.*) 2·5 mm. long, by only ·5 mm. in diameter, yellowish.

TROPICAL SOUTH AMERICA—New Granada, "prope Mompot" (*H. B. K. l. c.*); La Paila (*Holton*, no. 240); Brazil (*Spruce*, no. 1622); Ilhios (*Martius*); Colombia (*Lobb*).

§ 3. *Euvaginatæ.*

15. NAJAS MINOR, All. (Pl. XLI. figs. 105–115.)

N. minor, All. Fl. Pedem. ii. 221 (1785); Cham. in Linnæa, iv. (1829) 500; Kunth, Enum. iii. 113 (1841); A. Br. in Journ. Bot. ii. (1864) 277; Roth, Tent. Fl. Germ. ii. pt. 2, 500 (1793) (the species is often quoted as of Roth); T. Nees, Gen. Pl. Fl. Germ. iii. t. 44, figs. 22–24 (1858); Peterm. Deutschl. Fl. 539, t. 83. fig. 658 *m* (1849); Schkuhr, Bot. Handb. iii. 252, t. 296 (1808); Garcke, Fl. Nord u. Mitt. Deutschl. 300 (1849), & Illustr. Fl. Deutschl. 566 (1895); Pollini, Fl. Veron. iii. 48 (1824); Bertolini, Fl. Ital. x. 296 (1854); Magnus in Nuov. Giorn. Bot. Ital. ii. (1870) 188; Boiss. Fl. Or. v. 28 (1884); Hook. f. Fl. Brit. Ind. vi. 569 (1893); Franch. & Savat. Enum. Pl. Jap. ii. 13 (1879).

Var. *intermedia,* Cesati, Compend. Fl. Ital. 204 (1867).

N. alagnensis, Paglia in Att. Soc. Ital. Sci. Nat. x. (1867) 399, non Poll.; Masé, *l. c.* xi. (1868) 668.

N. dichotoma, Roxb. Hort. Beng. 71 (1814) (nomen), et Fl. Ind. iii. 749 (1832).

N. fragilis, Delile in Descr. Égypte, Hist. Nat. ii. 175 (1813); Rostk. & Schmidt. Fl. Sedin. 382 (1824).

N. heteromorpha, Griff. ex Voigt, Hort. Suburb. Calcutt. 694 (1845) (nomen).

N. marina, Linn. Fl. Suec. [ed. 2] 345 (1755) (in part, namely synonym from Micheli).

N. subulata, Thuill. Fl. Paris [ed. 2] 510 (1799).

N. ternata, Roxb. ex Griff. Not. iii. 183 (1851) et Ic. Pl. Asiat. t. 252 (1851), may belong to this species.

Caulinia fragilis, Willd. in Mém. Acad. Roy. Sci. Berl. 1798, 88, t. 1. fig. 2, et Sp. Pl. iv. 182 (1805); Poir. Ill. Gen. iii. 396, t. 799. fig. 2 (1833); Amici in Mem. Matem. e Fis. Soc. Ital. Sci. Modena, xix. (1823) (Fisica) 235, t. 8; T. Nees, Gen. Pl. Fl. Germ. iii. t. 45, figs. 1–11 (1858); Nocca & Balb. Fl. Ticin. ii. 163 (1821); Parlat. Fl. Ital. iii. 664 (1858).

C. gracilis, Pouzolz, Fl. du Gard, ii. 435 (1862) non Willd.

C. indica, Wall. List, no. 5183.

C. minor, Coss. & Germ. Fl. Paris, 575 (1845).

Fluvialis minor, Pers. Syn. ii. 530 (1807).

Ittnera minor, C. C. Gmel. Fl. Bad. iii. 592, t. iv. (1808).

Fluvialis Pisana, foliis denticulatis, J. Bauhin, Hist. iii. 779 (left-hand fig.) (1651).

Fluvialis minor, foliis angustissimis, denticulatis, deorsum reflexis, fructu acuto, tenuiori, monospermo, Micheli, Nov. Pl. Gen. 11, t. 8. fig. 3 (1729) (syn. exclus.).

There seems some confusion as to the plant described and figured as *Caulinia intermedia,* Nocca & Balb. Fl. Ticin. ii. 163, t. 15. The authors state that it is the *C. alagnensis,* Poll., i. e. *N. graminea,* and the description of the marginal teeth as very minute, often visible only by help of a lens, points to this species, and the "vaginula utrinque unidentata" may refer to the characteristic auricles. I have adopted this view. Cesati (Comp. Fl. Ital. 204), however, makes it synonymous with his *N. minor* var. *intermedia* and *N. alagnensis,* Masé; while Magnus, in his account of the Italian species of *Najas* (in Nuov. Giorn. Ital. ii. 188) cites it with similar synonymy as *N. minor* forma *intermedia* (Balbis), "folia valde elongata, erectiuscula; planta robustior. Talis occurrit in aquis profundioribus." Schumann also refers to it (in Mart. Fl. Bras. iii. pl. 3, 726, footnote) as belonging to *N. minor.*

A plant from Padua (Zuccarini), with leaves reaching 2·5 cm. long and ·75 mm. broad, represents, I think, this form, to which *N. alagnensis* of Paglia and of Masé probably refers.

Monoica, fragilis, valde ramosa, internodiis brevibus vel plus minus elongatis, inermibus; *foliis* e vagina lata linearibus, superne angustatis, falcate recurvatis, margine cum dentibus patentibus e basi lata spiniferis, laminæ latitudinem rarius æquantibus, instructa, foliis in plantis laxioribus subflaccidis plus minus elongatis nec recurvatis; *vaginis* truncate rotundatis, sæpe asymmetricis, cum dentibus subprominentibus superne marginatis, rarius plus minus auriculatis; squamulis intravaginalibus angusto-linearibus vel lineari-subulatis obtusis; *floribus* solitariis, masculis sessilibus, spatha ellipsoidea, in collum breviter cylindraceum sub ore spinuliferum desinente, perianthio apice bilabiato, ad antheram unilocularem arcte applicito; flore femineo achlamydeo, ovario ellipsoideo, stylo longo cylindrico, apice in stigmata bina diviso

fructu oblique lineari-oblongo, sub apice angustato, a pericarpio tenui semini conform arcte circumdato; *testa* dura brunnea cum seriebus scalariformibus foveolarum notata

The main stem branches immediately above the base. The habit varies according to the length of the internodes. These may be short and the whole plant small, densely leaved and bushy with a rounded outline from the apparently regularly dichotomous branching. Examples of this habit are common, the plants ranging from 4 to 6 cm. high. A laxer habit results from elongation of the lower internodes, and the bushy growth is confined to the ends of the longer shoots. In some cases growth is extremely lax, and the characteristic dichotomous habit quite disappears.

The plants seen range from 4 to 25 cm. in height or length of shoots. The lower internodes vary in length from scarcely 1 to 6 or 8 cm., with a maximum breadth of 1 mm.; their length decreases gradually upward, and at the tips of the shoots the leaves are closely crowded. *Leaves* linear-tapering, with a broad sheath, and in the more typical forms stiff, bent upward along the midrib and falcately recurved, while the margin bears a few patent teeth with a broad base ending in an upcurved or ascending spine. Where the habit of the plant is laxer the leaves are less rigid, longer, tapering very gradually, and not recurved. *Sheaths* broad, 2 to 3 mm. long, generally truncately rounded, often asymmetrical, with a few (generally 5 to 7) rather prominent teeth on each shoulder; teeth smaller from above downward, sometimes continued in a few smaller ones a short way down the sides; the shoulders are sometimes more or less raised into an auricle on which the prominent teeth are borne; the teeth may be more numerous than indicated above, as many as 18 have been counted on one shoulder, but in such cases there is considerable difference in size between the two sides of the sheath. *Blade* generally between 1 and 2 cm., but may reach 2·5 cm., ·3 to ·5 mm. broad; generally with 6 to 10 marginal teeth, or 12 to 15 in the longer leaves of the laxer plants. The leaf-width and the proportion of the length of the teeth to it vary considerably; in the same leaf the proportion may change from below upward, the length of the teeth, for instance, being about $\frac{1}{3}$ of the leaf-width in the lower part and $\frac{3}{4}$ in the upper, or nearly equal to it. Their length is generally between $\frac{1}{3}$ and $\frac{3}{4}$ the leaf-width, but may even exceed the latter. There are generally no teeth on the back, but occasionally the thickened midrib bears a few small teeth. The apex ends in one or a pair of spiny teeth. Intravaginal scales from ·75 to scarcely 1 mm. long.

Flowers protected by the leaf-sheath; male and female often found in successive leaf-axils. Male about 1·5 mm. long before elongation of stalk preceding anther-dehiscence. Spathe ellipsoidal, elongated below, and ending above the perianth in a shortly cylindrical neck, irregularly spiny-toothed at and beneath the mouth; perianth closely investing the shortly-stalked, ellipsoidal anther, above which it terminates in a pair of thick closed lips. Anther-wall delicate, enclosing the rounded or subelliptical pollen-grains When dehiscence is about to occur, the axis elongates and pushes the flower through the neck of the spathe, which becomes longitudinally split; the lips of the perianth separate and the pollen from the ruptured anther escapes through the aperture; length of dehiscing flower 2 mm. *Female flowers* about 2·5 mm. long, of which the sessile ovary occupies about a third; style long, almost cylindrical or slightly tapering,

ending in two unequal stigmas. *Fruit* 2 to 3 mm. long, about ·6 mm. broad. *Seed* with 12 to 18 longitudinal rows of transversely-elongated ladder-like pits, in dried plants plainly visible through the pericarp. The slight want of symmetry between the two sides of the seed and fruit is due to the raphe, which is conspicuous in the lower half of one side of the seed.

EUROPE—Generally distributed over the southern half of the continent from France through Switzerland, Southern Germany, Austria-Hungary, to South Russia; found also in the Spanish, Italian, and Grecian peninsulas. Seeds recently found fossil by Mr. Clement Reid at West Wittering in Sussex (pleistocene) and in the Cromer forest-bed at Pakefield (preglacial).

ASIA MINOR—Near Rhizé, Trebizond (*Balansa*).

SYRIA—Bishet-er-Râm (*Post*).

KURDISTAN—Between Erbil and Altun-Kupri (*Haussknecht*).

PERSIA—Ispahan, Karmanshah (*Haussknecht*).

AFGHANISTAN (*Griffith*, no. 5 in Herb. Kew.; a very lax form).

INDIA—Bengal, Mahanuddee (*Hook. f. & Thomson*); (*Griffith*, no. 5609/1 in part); Serampore (*Griffith*, no. 15652); Moulmein (*Parish*); Pondicherry (*Perrottet*); Madras (*Wall. List*, no. 45183, in part).

BURMAH—Pegu (*Kurz*, nos. 3295, 3309). *N. heteromorpha*, Griffith! (no. 5609/4 in Herb. Kew.) is a lax elongated form.

MALACCA (*Griffith*, nos. 5609/5, 5609/7).

MANCHURIA—Near Kiu Chau (*Newson*).

AFRICA—Libyan desert. In a spring at Bauiti (*Ascherson*, no. 498). A much broken fragment.

Var. SPINOSA, var. nov.

Planta foliis anguste linearibus, margine et dorso valde dentatis, dentibus marginalibus patentibus laminæ latitudinem subæquantibus vel vix brevioribus; fructu brevi.

Leaves rigidulous, 2 to 2·5 cm. long, with about a dozen spreading triangular teeth on each margin, tipped with a simple, ascending, brown spine, and almost as many subequal or slightly smaller teeth on the thickened midrib. *Sheaths* truncate, with several teeth on the upper margin. *Seed* 1·5 to 1·75 mm. long, narrowly ellipsoidal-oblong, tapering at the tip; testa with about a dozen rows of well-marked scalariform pits, replaced on the raphe by 4 rows of small, regular, quadrate ones.

INDIA (*Wight*, no. 2793).

16. NAJAS KURZIANA, sp. nov. (Pl. XLI. figs. 116–121.)

Herbula monoica gracillima, *foliis* tenuibus anguste linearibus planis, margine cum denticulis minutis numerosis instructo; *vaginis* breviter auriculatis, auriculis superne spiniferis; squamulis intravaginalibus subulatis; *floribus* aggregatis; spatha mascula ellipsoidea, apice subbreviter rostrata, ore aculeifera; anthera uniloculari (?); ovario nudo ellipsoideo, stylo in stigmata duo diviso; *fructu* parvo ellipsoideo-oblongo ad semen conformante; *testa* in seriebus circa 16 areolarum quadratarum conspicue lineata.

Apparently a very small plant; internodes less than ·3 mm. broad; leaves about 15 mm. long by about ⅓ mm broad, with 20 to 30 small teeth, recalling those of *Najas graminea*, consisting of an ascending short spine-cell supported on a very low shallow projection of the margin. *Sheaths* about 1·5 mm. long and not quite as broad; auricles low and rounded, beset on the upper edge with 4–5 sharp erect spine-teeth. Intravaginal scales ·6 mm. long. *Male flowers* about 1 mm. long; spathe ruptured laterally on dehiscence by the elongating flower-stalk, anther splitting at the top into two recurving lobes. *Ovary* with style and stigmas a little over 1 mm. long. *Fruit* 1 mm. long; testa plainly marked with about 16 rows of square pits, becoming small and narrow next the raphe and irregular towards the ends.

Described from a fragment kindly sent from Calcutta by Dr. Prain.

INDIA—North Bengal, between Kishenganj and Oolabena (*Kurz*, in Herb. Calcutta.)

17. NAJAS TENUISSIMA, A. Br.

N. tenuissima, A. Br. ex Magnus, Beitr. 24, 45, t. v. figs. 13, 14 (1870).

N. minor var. *tenuissima,* A. Br. in Journ. Bot. ii. (1864) 277.

Laxissima, ramis sæpius longis, tenuibus, laxiter foliosis; *foliis* longis tenuissimis et setaceis, patentibus vel subascendentibus, dentibus marginalibus vix protrusis cum aculeo ascendente terminatis; *vaginis N. minoris* subauriculatis et cum dentibus paucis prominentibus instructis; squamulis intravaginalibus parvis anguste linearibus; *floribus* ut in *N. minore*; *fructu* ellipsoideo cum pericarpio tenui a semine mox separabile, hoc anguste ellipsoideo; *testa* levi, areolas autem longas angustas quadrangulas permonstrante.

Plants with generally long, slender, straggling, laxly-leaved shoots from 12 to 22 mm. high, sometimes much smaller, one fruiting plant being only 5 cm. high. *Internodes* ·5 mm. or less in diameter, the lower 4 to 2·5 cm. long. *Leaf-sheath* with rounded sub-auricled shoulders, bearing each a few (4 to 6) prominent teeth; about 1·75 mm. long. *Blade* very narrow, linear, about 12 mm. long by ·25 mm. at its greatest breadth in the lower part; teeth about 8 on each margin, projecting but slightly, and terminating in a sharp, ascending, brown spine. Intravaginal scales ·4 mm. long. *Fruits* solitary or geminate in the leaf-axil, subsessile, 2·7 mm. long without the persistent style, ·75 mm. broad. The thin pericarp is easily separable from the seed and shows no markings. *Seed* narrowly ellipsoidal.

FINLAND—Prov. Tavastland, lake Wesijärvi (*Norrlin*); near Borga, "in aqua stagnante 'Moren' appellata" (*Sælan*); both in Herb. Berlin.

18. NAJAS GRACILLIMA, Magnus. (Pl. XLI. figs. 122–125.)

N. gracillima, Magnus, Beitr. 23 (1870); Morong in Mem. Torr. Bot. Club, iii. (1893) no. 2, 61, t. 68; Britton & A. Brown, Ill. Fl. North U.S. i. 81, fig. 182 (1896).

N. indica var. *gracillima,* A. Br. ex Engelm. in A. Gray, Man. Bot. [ed. 5] 681 (1868).

Planta gracillima, caulibus filiformibus elongatis; *foliis* planis, angustissime linearibus, superne attenuatis vel subsetaceis; margine inferne integra, superne denticulis spiniferis ascendentibus vix prominulis distantibus instructa; *vaginis* longis subcylindricis, auriculatis, auriculis brevibus latis irregulariter grosse-dentatis;

squamulis intravaginalibus anguste lineari-subulatis; *floribus* in ramulis brevibus diclinis; spatha mascula oblonga, superne in collum breve, ore longe spiniferum, attenuata; ovario nudo suboblongo, stylo cylindrico, in stigmata duo diviso; *fructu* lineari-oblongo; *semine* ruguloso cum areolis quadrilateralibus elongatis in seriebus numerosis lineato, raphe valde distincta.

Plants slender and delicate, 10 to 40 cm. high according to Morong; stems almost filiform, branching from the base, rooting at the nodes; branches spreading. Lower internodes 1·5 to 4 cm. long, diminishing to about 1 cm. a few centimetres below the apex. *Leaf-blade* often at an angle with the well-developed sheath, generally 2 to 2·5 cm. long, but reaching 3 cm., and scarcely ·25 mm. or less in width. Apex ending in one or two sharp spines; margin with about 7 or 8 distant teeth, absent from the lower part; teeth small, projecting slightly, consisting of sharp ascending spine-cells raised above the margin on two cells or on a shallowly triangular few-celled process. *Sheaths* 1·5 to 2·5 mm. long, auricles bearing 4 to 6 large, irregular, brown-spine-bearing teeth. Intravaginal scales about ·75 mm. long.

Flowers borne on short axillary shoots, male and female occurring on the same shoot. Male 1·5 mm. long; spathe oblong, narrowing below and passing above into a narrowly obconical neck, the mouth of which bears several (4) long, sharp, brown spines; perianth as usual, as also dehiscence of anther on elongation of the pedicel. *Ovary* about 2 mm. long; one of the two stigmas was on one occasion seen to end in a brown spine. *Fruit* subsessile, 2·6 to 3·3 mm. long, narrowing at the apex and slightly falcate, crowned by the withered style; pericarp when dry thin and membranous, conforming closely to the seed. *Testa* bearing numerous longitudinal rows of four-sided areolæ, about twice as long as broad, becoming fewer and irregular at the ends.

Eastern United States—Rhode Island (*Lenormand*); Albany (*Engelmann*); Missouri (*Engelmann*); Bristol, Pennsylvania; Boston (*Booth*).

19. Najas Kingii, sp. nov. (Pl. XLI. figs. 126–131.)

Monoica, ramis longis effusis apice dense ramulosis; *foliis* longis lineari-angustatis, margine cum dentibus ascendentibus pluribus obtuse triangulis aculeiferis, laminæ latitudinis dimidium æquantibus vel brevioribus, instructa, nervo mediano et lineis brevibus horizontalibus conspicuis; *vaginis* magnis, marginibus late imbricatis, basi attenuatis, superne truncate rotundatis et dense dentatis; squamulis intravaginalibus minutis, e basi latiore filiformibus; *floribus* illis *N. foveolatæ* similibus; *fructu* parvo ellipsoideo, pericarpio tenui ad semen flavum conformante, testa cum areolis parvis subsexangulis manifeste notata.

A unique specimen. *Shoots* long, straggling, ending in a dense bushy growth; lower internodes 3 to 4 cm. or more long, generally about ·7 mm., sometimes nearly 1 mm., in breadth. *Leaves* reaching, without the sheath, 3·5 cm. in length, with a width of ·75 mm. in the lower part; apex uni- or bidentate; each margin with 16 to 19 teeth, consisting of a small obtusely triangular outgrowth ending in a dark brown sharp spine. *Sheath* large and broad, with overlapping edges broadening upward from the base; upper margin truncate, with broadly rounded shoulders bearing generally 10 teeth, which

become gradually smaller near the edge; length 2 to 2·5 mm., breadth at the top 1·5 to 2 mm. Intravaginal scales scarcely ·5 mm. long.

Flowers solitary, male and female occurring on the same shoot. Male sessile, 2·3 to 2·6 mm. long, about the same length as the protecting leaf-sheath. Spathe ellipsoidal, ending in a cylindrical neck about ·5 mm. long, which bears at the mouth numerous pointed spines; perianth fitting closely to the ellipsoidal quadrilocular anther, above which it ends in two thickened lips. Ovary naked, 2·5 mm. long. Stigmas two. *Fruit* ·75 to 2 mm. long. *Testa* plainly marked with about 30 rows of small subhexagonal pits.

SOUTH ANDAMAN—Navy Bay Tea Gardens (*King*, in Herb. Calcutta).

Distinguished from *Najas foveolata* by its broad, truncately-rounded sheath, and small fruit.

20. NAJAS LACERATA, sp. nov. (Pl. XLI. figs. 132–138.)

Dioica (?), rigidula, ramis dichotome ramulosis; *foliis* ascendentibus linearibus, superne angustatis, planis, adultis a nervo mediano et lineis transversalibus percursis, dorso carina dentata instructis; dentibus marginalibus numerosis patenti-ascendentibus, laminæ latitudinis dimidium æquantibus vel minoribus; vaginis subcylindricis auriculatis, auriculis grosse- et paucidentatis; squamulis intravaginalibus lineari-subulatis; *floribus* masculis solitariis, spatha lacerata, anthera quadriloculari; *flore femineo* . . . . ; *fructu* . . . . .

Shoots dichotomously spreading to 15 cm. long; basal internodes 3 to 5 cm. long, becoming shorter above, subcompressed, ·7 mm. or less in width. *Leaves* to 2·5 cm. long by about ·5 mm. broad below; teeth about 12 each side, more prominent and ascending in the shorter young leaves at the tips of shoots. *Sheaths* 2 to 3 mm. long and about as broad or slightly narrower, the top of the rather broad auricle deeply cut into (generally) 2 to 4 spiny-tipped teeth. *Male flower* 2·75 mm. long, the spathe deeply cut into irregular segments bearing one or more brown spines.

INDIA—Tinnevelly (*Beddome*, no. 8202, in Herb. Mus. Brit.); Madras (*Wight*, in Herb. Kew.); Bengal, Upper Cobaduc, Zillah Jessore (*Clarke*, no. 4366) (no flowers present, but apparently conspecific).

21. NAJAS FOVEOLATA, A. Br. (Pl. XLI. figs. 139–144.)

N. foveolata, A. Br. ex Magnus, Beitr. p. vii (1870).

N. indica, Zoll. Syst. Verzeichn. Heft 1 & 2, 74 (1854), non Chamisso.

Monoica, ramis elongatis patentibus, plus minus dichotome et superne dense ramulosis; internodiis tenuibus brevibus vel elongatis; *foliis* sæpius ascendentibus, linearibus, superne valde angustatis vel setaceis, planis, cum nervo mediano distincto et dentibus marginalibus sæpius ascendentibus parvis subtriangulis longe aculeatis, in basi laminæ rarioribus, instructis; *vaginis* subanguste cylindricis, utrinque breviter auriculatis, auriculis latis paucidentatis; squamulis intravaginalibus anguste linearibus; *floribus* solitariis, masculis breviter pedicellatis, spatha valde rostrata ore aculeifera, anthera quadriloculari; ovario ellipsoideo cum stylo angusto stigmatibus

duobus terminato; *fructu* ellipsoideo, pericarpio tenui ad semen conformante; testa cum areolis distinctis in medio subquadratis in serie longitudinali notata.

Plants with spreading shoots, 16 to 20 cm. or more in length, with a greater or less tendency to a dichotomous form of branching, producing in the higher grades a more or less bushy growth. *Internodes* varying very much in length; generally 3 to 4 cm. long in the lower part of the shoots, becoming much shorter above; in lax specimens longer, in close-grown specimens shorter; diameter generally about ·5 mm., but may reach ·75 mm. *Leaves* thin, ascending, or the lower ones more spreading; the larger with short lines running horizontally towards the margin, 1·5 to 3·5 mm. long by ·3 to nearly 1 mm. broad. *Sheaths* generally 2·5 to 3 mm. long, auricles bearing a few (4 to 6) spiny teeth above and on the outer edge. Marginal teeth generally ascending, rarely patent, consisting of a small subtriangular outgrowth of the leaf-surface, terminating in a slender sharp spine; 6 to 20 on each side, often scarce in the lower part of the leaf.

Male and female flowers on the same shoot; male 2·5 to 2·75 mm. long; spathe ellipsoidal, ending in a cylindrical beak $\frac{1}{4}$ to $\frac{1}{3}$ of the whole length, terminating in a fringe of slender, sharp, brown spines; perianth bilabiate, closely fitting to the anther, as in *Najas minor*, the thickened lips meeting at the top; pollen-grains oblong. Dehiscence as in *N. minor*. Female naked and sessile, 2·5 to 3 mm. long; one of the stigmas occasionally terminating in a brown spine. *Fruit* 2·25 to 2·5 mm. long. *Seed* plainly marked with about 20 rows of quadrate to polygonal pits. In the middle of the seed the markings are more regular, subquadrate, and about as broad as long; above and below they become less regular and polygonal.

INDIA—Bengal (*Kurz*; *Clarke*, no. 31879); Rajpore Jheels (*Kurz*); Calcutta Jheels (*Thomson*); Gwalior (*Maries*); Behar (*Hook. f.* no. 639).

SUMBAWA (*Zollinger*, no. 3398).

TIMOR—Koepang (*Martens, Naumann*).

PHILIPPINES—(*Commerson*); Manila (*Meyen*); (*Barthe*, del fundo de la laguna de Bay, 'Voyage de la 'Sibylle'').

MOLUCCAS—In lacu prope Gorontales.

JAPAN (?)—(*Miquel*, a doubtful fragment, with young flowers only, in Herb. Berlin).

Var. MINOR, var. nov.

Planta foliorum dentibus minus conspicuis; fructu minore.

Resembles the type in habit, but the teeth on the adult leaves are only about $\frac{1}{3}$ to $\frac{1}{4}$ of the leaf-width. The leaves reach about 2 cm. in length, with a breadth of nearly ·5 mm. just above the sheath, tapering to ·3 mm. below the apex. Sheath-auricles rather long and sometimes falcate. *Seed* ellipsoidal, brown, 1·5 mm. long, with 14 rows of large conspicuous, more or less irregularly quadrate, or polygonal markings, becoming smaller near the raphe.

WESTERN INDIA—Kaktee tank, near Belgaum (Herb. Calcutta).

22. NAJAS FALCICULATA, A. Br. in Journ. Bot. ii. (1864) 278; Hook. f. Fl. Brit. Ind. vi. 569 (1893). (Pl. XLII. figs. 145–151.)

Monoica, graminosa, caulibus tenuibus elongatis erectis, ramis brevibus ascendentibus;

foliis anguste linearibus, sub apice bispinuloso angustatis, planis, dentibus marginalibus parvulis; *vaginis* auriculatis, auriculis sæpe falcatis, paucidentatis; *floribus* solitariis, masculis breviter pedicellatis, spatha rostrata ore aculeifera; ovario nudo, stylo stigmatibus duobus terminato; *fructu* anguste oblongo, pericarpio (sicco) tenui ad semen conformante; *testa* cum areolis quadratis minutis numerosis longitudinaliter notata.

Of slender grass-like habit; internodes 2·5 to 3 cm. long, becoming shorter near the densely-leaved tips of the shoots, ·5 to ·6 mm. broad.

Leaves 1·6 to 2 cm. long by ·5 to ·6 mm. broad; marginal teeth $\frac{1}{3}$ to $\frac{1}{4}$ the leaf-width, 18 to 25 on each margin at regularly decreasing intervals from base to apex. *Sheath* 2 by 1·5 mm., raised into longer or shorter auricles, which are often falcately curved, and entire on the inside, with 3 to 5 teeth on the outer edge. Intravaginal scales subulate, ·6 mm. long. *Spathe* of male flower ellipsoidal, narrowing into a somewhat shorter neck, ending in a few unequal teeth. Pericarp conforming to the seed, which is ellipsoidal, oblong, flattened along the raphe, about 2 mm. long, with about 30 rows of small, regularly quadrate, thick-walled pits.

INDIA—Madras (*Wight*); Tuticorin (*Wight*, herb. propr. no. 1217)?

JAVA—(*Horsfield*).

PHILIPPINES—Manila (*Martens*).

A very doubtful species, of which more material is needed. Evidently near *N. foveolata*, but distinguished by the smaller leaf-teeth and smaller and more numerous markings on the testa.

The specimens from Tuticorin are included with some doubt. They are old and much broken, with imperfect leaves, and bear no flowers. The ripe seeds are ellipsoidal-oblong, 1·5 mm. long. They may represent a small-fruited variety.

23. NAJAS BREVISTYLA, sp. nov. (Pl. XLII. figs. 152–157.)

Monoica, ramis tenuibus elongatis apice subdichotome ramulosis, ramulis brevibus dense foliatis; *foliis* rigidulis e vagina auriculata dentata subfalcate recurvatis, lamina lineari superne angustata, margine cum dentibus ascendentibus, e basi lata spiniferis, laminæ latitudinis dimidium æquantibus, instructa; squamulis intravaginalibus lineari-subulatis; *floribus* in ramulis brevissimis axillaribus aggregatis, at perpaucis; anthera ellipsoidea quadriloculari breviter stipitata cum spatha collo cylindrico spinifero terminata involuta; ovario nudo ellipsoideo cum stylo brevi cylindrico, apice in stigmata bina diviso; *fructu* parvo ellipsoideo cum stylo diu persistente rostrato; *testa* brunnea cum areolis subquadratis manifeste lineata.

A delicate plant with long, slender, spreading shoots, brittle when dry, the lower internodes reaching 2·5 to 3·5 cm. long by ·3 mm. or a little more in width. Tips of shoots subdichotomously branched and densely leaved; short and leafy branches spring from the main shoot. *Leaves* at lower nodes elongated, 2 cm. long by ·3 mm. broad, on the branchlets only about 1 cm. long; sheath cylindrical, 1·3 to 2 mm. long, including auricles, which are generally short, but sometimes two-fifths as long as the sheath, and bear several, generally 3 to 7, erect spiniferous teeth; blade tapering gradually upward,

with 10 to 22 marginal teeth, consisting of a sharp ascending spine on a shallowly triangular base. Intravaginal scales ·5 mm. long. *Flowers* on very short shoots on the branchlets, each with a few flowers; male and female occur on the same shoot. Male 1·8 mm. long, anther dehiscing in the usual way; pollen-grains oblong. Female probably about the same length before pollination, characterized by the stout cylindrical style and short, generally unequal, stigmas. *Fruits* usually in pairs on the reduced fertile shoots, about 1 mm. long, the thin pericarp, in the dry state, closely conforming to the testa and showing about 20 rows of well-marked squarish pits.

INDIA—Assam (*Jenkins*, in Herb. Kew.); Calcutta (Herb. Hook. 1867).

24. NAJAS TENUIFOLIA, R. Br. (Pl. XLII. figs. 158–162.)

N. tenuifolia, R. Br. Prodr. 345 (1810); Kunth, Enum. iii. 114 (1841); Benth. Fl. Austral. vii. 181 (1878).

N. graminea var. *tenuifolia*, A. Br. in Journ. Bot. ii. (1864) 278.

Planta caulibus sæpe erectis vel basi repentibus, ramis brevioribus ascendentibus, sæpe magis elongatis et laxius foliatis; *foliis* planis ascendentibus, anguste linearibus, acutis, vel setaceis, margine denticulis numerosis ascendentibus instructa; *vagina* angusta longe auriculata; squamulis intravaginalibus subulato-filiformibus; *floribus* solitariis, masculis breviter pedicellatis, spatha ovoidea in collum breve ore longe spiniferum desinente, anthera quadriloculari; *ovario* nudo, stylo cylindrico in duo stigmata diviso; pericarpio ad semen oblongum vel ellipsoideo-oblongum arcte applicito; *testa* in areolis minutis quadratis regulariter lineata.

Plants often between 11 cm. and 24 cm. high, apparently erect from the base or creeping and rooting at the lower nodes, the ascending branches shorter than the main stem, and giving the whole a spreading tree-like habit, more or less dense above; the lower internodes 2 cm. long by ·75 mm. broad, becoming gradually shorter to 1·5 cm. in the upper part, and filiform. Often, however, the shoots are longer (to 32 cm.), spreading laxly and flexuose, with internodes 4 to 5·5 cm. long, diminishing to 2·5 to 1·5 cm. a few centimetres below the apex, with a width of from ·7 mm. below to ·5 mm. or less above. *Leaves* weak, thin, flexuose, tapering to an acute apex, often setaceous above, 2·5 to 3·5 cm. long by ·5 to ·75, or nearly 1 mm. greatest breadth. There is a row of long, slender, colourless fibres beneath the epidermis at the margin, which bears on each side generally 18 to 20 slightly projecting teeth. *Sheaths* small and narrow (3 mm. long), bearing large triangular auricles more than a third of the whole length, with numerous subprominent suberect teeth, chiefly on their outer margin. Intravaginal scales ·75 to ·8 mm. long.

Male flowers very rare (only one found after repeated search); spathe close-fitting, neck with several long sharp spines at the mouth; anther apparently four-celled. *Female flowers* 2 mm. long, the short ellipsoid ovary passing into a tapering cylindrical style. *Fruit*, when dry, consisting of a membranous pericarp bearing the withered style. *Seed* 2·3 mm. long by ·5 in diameter; raphe prominent in the lower half; testa with about 30 rows of small quadrate areolæ with thick separating walls, arranged in regular longitudinal series; near the tip and the raphe they become polyhedral and less regular in shape.

AUSTRALIA—Cavern Is., Gulf of Carpentaria (*R. Brown*, 1803); Richmond, New South Wales (*Caley*, 1803 & 1804); Nepean River (*Woolls*); Port Mackay, Queensland (*Tyson*).

25. NAJAS BROWNIANA, sp. nov. (Pl. XLII. figs. 163–167.)

"Herba aquatica graveolens odore *Charæ vulgaris*" *; caulibus debilibus ramosis, internodiis filiformibus; *foliis* tenuissimis, margine sæpe involuto denticulis minutis distantibus instructo; *vagina* anguste cylindrica, breviter et late auriculata, auriculis obtusis subprominenter paucispinosis; squamulis intravaginalibus subulatis; *floribus* in ramulis brevibus aggregatis, masculis breviter pedicellatis solitariis, spatha suboblonga in collum breve cum ore obliquo spinifero desinente, ovario nudo; stylo superne attenuato in stigmata longa duo diviso; *semine* ellipsoideo, testa in areolis quadrilateralibus numerosis subirregulariter lineata.

Shoots 15 cm. long, copiously branching; internodes 1 cm. long or less. *Leaves* 1·5 to 2 cm. long by one-sixth of a millimetre or less in breadth, very weak, filiform, often with incurved margins for the greater part of their length; margins with 10 to 15 slightly projecting subascending spines, often broken off or absent, except in the upper part; apex ending in a sharp spine. *Sheaths* 1·6 mm. long. Intravaginal scales about ·5 mm. long. Young leaves very delicate, transparent and flat.

Flowers: several crowded together on short lateral shoots; male flowers few, apparently solitary near the top of the shoot, 1·2 mm. long; spathe with a short cylindrical neck with an irregular spinuliferous mouth; anther enclosed in the perianth, shortly stalked, ellipsoidal-oblong; female flowers: several close together at successive nodes, about 1·75 mm. long, consisting of a short ellipsoidal ovary passing into a tapering style; stigmas subequal or sometimes unequal. *Fruit* with a thin pericarp crowned with the withered style, and conforming closely to the ellipsoidal seed. *Seed* 1·5 mm. long by ·4 to ·5 mm. in diameter; raphe prominent; testa with about 25 rows of somewhat irregular four-sided areolæ, rather longer than broad in the middle of the seed. The areolæ are larger and more irregular than in *N. tenuifolia*, and the seed is smaller and proportionately broader.

NORTH AUSTRALIA—Cavern Is., Gulf of Carpentaria (*R. Brown*, Jan. 14, 1803).

26. NAJAS LEICHHARDTII, Magnus. (Pl. XLII. figs. 168–171.)

N. Leichhardtii, Magnus, Beitr. 46, t. viii. figs. 1–8 (1870).

Foliis in parte inferiore crassiusculis superne, planis, flexuosis, margine cum dentibus prominentibus instructa; *vagina* angusta valde auriculata; squamulis intravaginalibus subulatis; *floribus* solitariis, masculis cum spatha ellipsoidea in collum longum ore spinosum desinente, anthera quadriloculari; ovario nudo, anguste ovali, stylo in stigmata duo diviso; *fructu* . . . . .

A fragment consisting of a shoot 12 cm. long, with a few short branches; internodes diminishing from 3·5 cm. to ·7 cm., ·5 mm. in width. *Leaves* 1·5 to 2·5 cm. long by ·2

* R. Brown, MS. in Herb. Mus. Brit.

to ·4 mm. broad, with 10 to 17 marginal teeth, which are relatively large triangular outgrowths capped with a sharply-pointed spine-cell, and often equal in length to the leaf-width; there are no hypodermal strengthening fibres. *Sheaths* 3·3 to 3·5 mm. long; auricles about $\frac{1}{4}$ the length of the whole, with 3 to 5 suberect teeth on the narrow apex and outer margin, and sometimes continued for a short distance down the sheath-margin. *Male flowers* 3 mm. long; the narrow neck of the spathe ends in a few long sharp spines; the two lips of the perianth are large and conspicuous. *Female flowers* 3·25 mm. long, the slender style dividing into two long narrow-linear stigmas. *Fruit* absent.

AUSTRALIA—(*Leichhardt*).

Very near *Najas tenuifolia*, but, so far as it is possible to judge from the very scanty material, distinguished by its more prominent leaf-teeth, and the longer neck of the male spathe.

27. NAJAS AUSTRALIS, Bory. (Pl. XLII. figs. 172–176.)

N. australis, Bory ex Cham. in Linnæa, iv. (1829) 501.

N. minor var. *indica,* A. Br. in Journ. Bot. ii. (1864) 278, in part.

Caulinia alternifolia, Willd. ex Cham. *l. c.*

Planta laxissima, ramis tenuibus elongatis, internodiis sæpe filiformibus; *foliis* longis anguste linearibus, superne angustatis et subsetaceis, ascendentibus, debilibus, in siccis flexuosis, nervo mediano cum lineis horizontalibus in foliis validioribus conspicuis, dentibus marginalibus breviter triangulis, superne magis prominentibus; *vaginis* sæpe cylindricis, superne late rotundatis et dentibus minutis numerosis instructis; squamulis intravaginalibus anguste linearibus obtusis; *floribus* masculis . . . . .; femineis brevibus vagina inclusis; ovario nudo ellipsoideo, stylo brevi in stigmata duo diviso; *fructu* anguste ellipsoideo, pericarpio semen rugulosum arcte includente; testa areolis minutis quadratis regulariter notata.

A very lax plant, with a grass-like, more or less strict habit, or sometimes diffuse. Shoots long and slender, reaching 50 cm., and probably more; lower internodes 3 to 8 cm. long, ·75 to 1·3 mm. broad, becoming much shorter above, 1·5 to 1 cm., and scarcely ·5 to ·3 mm. broad. *Leaves,* when dry, flexuose or curled; lamina generally 2 cm. long by ·3 mm. broad, sometimes reaching 3·5 cm. by ·6 mm., each margin bearing about 12 teeth, or sometimes as many as 18, which are shortly projecting, shallowly triangular outgrowths, ending in an ascending brown spine, the whole $\frac{1}{5}$ to $\frac{1}{3}$ of the leaf-width in the lower part of the lamina, becoming more prominent above as the leaf-width diminishes. *Sheaths* 3·5 to 5 mm. long by 2 to 3 mm. broad, when opened out, usually with broadly rounded shoulders bearing numerous (10 to 16) small teeth. Intravaginal scales tapering slightly to a blunt apex, ·75 mm. long. *Male flowers* absent. *Ovary* 1·75 mm. long. *Fruit* 2·75 mm. long, pericarp closely enveloping the seed, which is marked with about 25 regular parallel rows of square areolæ, not visible on the raphe.

Very near the Malayan *N. foveolata*, but distinguished by the very lax habit, rounded leaf-sheath, and slender seed with smaller markings.

MAURITIUS—(*Bory de St. Vincent*; *Commerson*; *Robilliard*; *Johnston*, Rivière de Motra; and others).

BOURBON—(In Herb. Link.).

MADAGASCAR—(*Baron*, no. 2629; *Humblot*, no. 351).

28. NAJAS SETACEA, sp. nov. (Pl. XLII. figs. 177–182.)

N. minor var. *setacea*, A. Br. in Journ. Bot. ii. (1864) 278.

Debilis, caulibus filiformibus; *foliis* setaceis, linearibus, cum apice obtuso et margine minute denticulato, in parte inferiore sæpius integro; *vaginis* subcylindricis late auriculatis, auriculis paucidentatis; squamulis intravaginalibus lineari-acuminatis; *floribus* masculis . . . .; ovario nudo ellipsoideo, stigmatibus duobus; *fructu* parvo oblongo, pericarpio tenui ad semen rugulosum adhærente; *testa* cum areolis quadratis minutis numerosis subdistincte lineata.

Shoots weak, with filiform internodes generally 1·5 to 2·5 cm. long. *Leaves*, including the sheath (2·25 mm.), 1·4 to 1·7 cm. long by ·3 to ·4 mm. broad, very narrowly setaceous, uniformly linear, tapering very slightly at the blunt 1–2-dentate apex; marginal teeth 20 to 30, very small, consisting of an ascending spine raised but slightly above the leaf-margin; they are generally wanting in the lower part, and are often broken off from older leaves. *Sheath* passing into well-marked broad auricles, the margin of which is broken into a few (4 to 5) prominent spine-tipped teeth. *Ovary* 2 mm. long; style tapering. *Fruit* 1·5 to 1·75 mm. long. The membranous pericarp conforms closely to the seed, which is marked with about 30 parallel longitudinal rows of fairly distinct square areolæ, absent from the prominent raphe.

BOURBON—Braun states that he received the plant from Mougeot without the collector's name.

29. NAJAS HORRIDA, A. Br. (Pl. XLII. figs. 183–191.)

N. horrida, A. Br. ex Magnus, Beitr. pp. vii, 46, 47 (1870).

N. pectinata, Magnus, in Aschers. & Schweinf. Illustr. Fl. Égypt. [Mém. Inst. Égypt. ii. pt. i.] 145 (1889), et in Ber. Deutsch. Bot. Ges. xii. (1894) 219.

Caulinia pectinata, Parl. Fl. Ital. iii. 665 (1858).

Robusta vel interdum gracilis, caulibus elongatis effusis, ramis brevibus dense fruticoso-ramulosis; *foliis* crassiusculis, rigidis, plicatis, falcate recurvatis, margine cum dentibus magnis patentibus armato; *vagina* late truncate-rotundata, superne denticulata; squamulis intravaginalibus lineari-angustatis, acutis; *floribus* solitariis, masculis sessilibus, spatha anguste ovoidea vel ovoideo-oblonga, in collum breve cum ore obliquo spinulifero desinente; *ovario* nudo, ellipsoideo, stylo brevi conico in stigmata duo diviso; *fructu* oblongo-ellipsoideo; testa seminis in areolis subquadratis minutis distincte lineata.

Main shoots long and spreading, with short lateral branches, passing after a few short internodes into a dense bushy head. Lower internodes often very long, sometimes reaching 12 cm., often about 5 or 6 cm.; breadth ·5 to 1 mm., in the upper part of the main shoots generally between 1 and 2 cm. *Leaves* with minutely bispinulose apex, the

margins armed with large triangular spreading teeth, longer than the leaf-width, ending in a small, rigid, dark brown spine. In robust specimens the blade reaches 2 cm. in length by ·75 mm. in width about the middle, with about 8 teeth projecting 1 mm. from the margin in the lower half, becoming shorter as the leaf narrows above, but still slightly exceeding its width; the midrib is prominent, and narrow bands run at right angles from it towards the margin; the broad truncately-rounded sheath is 2·5 to 3·3 mm. long by 1·75 to 3·3 mm. broad; the rounded shoulders bear from 4 to 6 minute teeth, decreasing in size from above downward. In the more delicate specimens the blade is 8 to 11 mm. long by ·5 mm. broad, bears 4 to 6 teeth exceeding the leaf-width, and the sheath is about 1·5 mm. long. Intravaginal scales ·75 mm. long.

Male flowers 2·5 to 3 mm. long; spathe-neck cylindrical, scarcely ·5 mm. long, the mouth bearing a few short spines; perianth subelliptical, narrowing abruptly below the two-lipped apex. *Ovary* about 2 mm. long; stigmas broad, spreading, linear-tapering. *Fruit* 2 to 2·5 mm. long, tapering above, and crowned with the withered style and stigmas. *Seed* plainly marked with about 20 rows of squarish pits.

TROPICAL AFRICA—Central and East: Gazelle river (*Schweinfurth*, nos. 1137 in part, and 1228 in part); Fazogl (*St. Ange*); Lake Tanganyika (*Hore*); Ressano Garcia, Mozambique (*Schlechter*, no. 11883). West: Nupe (*Barter*, no. 1065), Cameroon (*Preuss*, no. 452; *Staudt*, no. 488); Lac de Ghier, Senegal (*Roger*); Marais du Walo, près Keurmbaye (*Leprieur*).

Note.—I find no evidence of the spathe which Magnus describes and figures for this species (see Ber. Deutsch. Bot. Ges. xii. (1894) fig. 2). I have not seen the Egyptian specimen on which the account is based, and it may perhaps represent another species.

30. NAJAS INTERRUPTA, K. Schum. in Engl. Pflanz. Ost-Afr. Th. C, 94 (1895); Arth. Bennett in Fl. Capens. vii. 51 (1897).

Fusco-viridis, caulibus gracilibus rigidulis, internodiis teretibus inermibus elongatis; *foliis* e vagina magna brevibus lineari-angustatis obtusiusculis, margine irregulariter paucidentata, dentibus in parte inferiore laminæ latitudinem æquantibus robustis triangularibus patentibus, aculeo brunneo-rufescente ascendente terminatis, superne deminuentibus et pro rata brevioribus; *vaginis* sæpius asymmetricis, in folio superiore cujusque paris majore, humeris sæpe latissime rotundatis, interdum plicatis plus minus truncatis, superne cum denticulis paucis minutis instructis; squamulis intravaginalibus lanceolatis vel triangulari-lanceolatis acutis; *floribus* solitariis, spatha mascula ellipsoidea apice in collum cylindricum desinente, ovario nudo anguste ellipsoideo, stylo cylindrico in stigmata bina (vel terna) apice aculeata desinente; *fructu* fusiformi; testa cum areis quadratis in seriebus circa 20 ordinatis manifeste exsculpta.

Habit rather straggling and wiry. *Internodes* 1·5 to 2 cm. in upper part of shoots. *Leaves* about 1 cm. long, including the sheath, about ·5 mm. greatest breadth, not including the teeth; margin asymmetrically toothed, 5 or 6 teeth on each side. *Sheath* 2 to 3 mm. long by 1·7 to 2·75 mm. broad, with 3 to 6 small teeth on each shoulder; that of the upper of each leaf-pair larger, more asymmetrical, and markedly amplexicaul.

Only empty spathes of male flowers present, 1 mm. long, containing the broken flower-pedicel. *Ovary* with style and stigmas 2 mm. long; stigmas of those examined ending in a small yellow-brown spine-cell. *Seed* 2 mm. long by ·5 mm. in diameter, dull yellowish, plainly marked with rows of squarish pits, which become elongated on the raphe and smaller, irregular, and obscure towards the ends.

EAST TROPICAL AFRICA—(*Fischer*, no. 614).

SOUTH AFRICA—Transvaal (*Bolus*, no. 6283).

§ 4. *Nudæ.*

31. NAJAS GRAMINEA, Delile. (Pl. XLII. figs. 192–201.)

N. graminea, Delile in Descr. Égypte, Hist. Nat. ii. 282, t. 50. fig. 3 (1813); Cham. in Linnæa, iv. (1829) 502; Kunth, Enum. iii. 115 (1841); A. Br. in Journ. Bot. ii. (1864) 278; C. Bailey, ib. 1884, t. 250; Arcang. Fl. Ital. [ed. 2] 101 (1894); Cesati, Compend. Fl. Ital. 205; Magnus in Nuov. Giorn. Bot. Ital. ii. (1870) 189; Boiss. Fl. Or. v. 28 (1884); Hook. f. Fl. Brit. Ind. vi. 569 (1893); K. Schum. in Mart. Fl. Bras. iii. pt. 3, 730, t. 124. fig. 2 (1894).

Var. *Delilei*, Magnus in Ber. Deutsch. Bot. Ges. i. (1883) 522, et ex Aschers. & Schweinf. Ill. Fl. Égypt. [Mém. Inst. Égypt. ii. pt. i.] 146 (1889); C. Bailey in Journ. Bot. xxii. (1884) 305, t. 249; K. Schum. in Mart. Fl. Bras. iii. pt. 3, 731.

Var. *vulgata*, Magnus ex Aschers. & Schweinf. *l. c.* 145.

N. alagnensis, Pollini, Fl. Veron. iii. 49 (1824); Cham. in Linnæa, iv. (1829) 502; Kunth, Enum. iii. 115 (1841); Bertolini, Fl. Ital. x. 296 (1854) (*alaganensis*).

N. seminuda, Griff. in Voigt, Hort. Suburb. Calc. 694 (1845); id. Notul. iii. 184, et Icon. Pl. Asiat. tt. 251. fig. ii. 253, 254 (1851).

N. serristipula, Maxim. in Bull. Acad. St. Pétersb. xii. (1868), 72 [Mél. Biol. vi. 275]; errore *N. serrati-stipula*, Magnus, Beitr. 44 (1870), et in Engl. & Prantl, Pflanzenfam. ii. i. 218 (1889).

N. tenuifolia, Aschers. in Att. Soc. Ital. Sci. Nat. x. (1867) 267, non R. Br.

N. valisnerioides, Griff. Notul. iii. 180, probably belongs here, as the author says it "appears to vary in the absence of a tunic to the stamina."

Caulinia alagnensis, Pollini, Hort. & Prov. Veron. 26 (1816), et Fl. Veron. iii. 49 (1824); Parl. Fl. Ital. iii. 665 (1858) (*alaganensis*).

C. intermedia, Balb. in Mem. R. Accad. Sci. Torin. xxiii. (1818) 105 (nomen), Nocca & Balb. Fl. Ticin. ii. 163, t. 15 (1821).

Planta inermis, sæpius gracile plumosa, super basin longe ramosa; *caulibus* inferne repentibus tum decumbentibus, sæpe longe effusis, tenuibus subrigidis, ramulis brevibus dense foliatis; *foliis* anguste linearibus, superne angustatis patentibus, sæpe recurvatis, margine cum spinulis minutis numerosis ascendentibus instructa; *vaginis* longe auriculatis; squamulis intravaginalibus subulato-filiformibus; *floribus* in ramulis, solitariis vel paucis aggregatis; masculis breviter pedicellatis, nudis, perianthio ad antheram quadrilocularem applicito, superne bilobo, lobis breviter rotundatis, polline oblongo et rotundo; ovario nudo ellipsoideo, stylo cylindrico in stigmata duo longa linearia diviso; *fructu* solitario vel paucis aggregatis, anguste ellipsoideo-oblongo, apice subattenuato; *testa* in areolis parvis sub-quadratis vel plurangulis numerosis subirregulariter, sed sæpius distincte lineata.

Habit grass-like, the long shoots rooting at the lower nodes and forming new plants by

death of the older connecting parts Length of shoots varying from a few inches to over 2 feet. Lateral branches sometimes very short, forming a densely-leaved tassel, and, when the internodes on the main stem are also short, giving the plant a dense cylindrical habit. *Internodes* terete, sometimes broadening upward on the stronger shoots, the lowest generally from 2 to 4·5 cm. long by 1 to 1·75 mm. wide, becoming smaller and often fairly regular in size about the middle, and then decreasing to the apex, where the leaves are densely crowded; in the spreading forms the internodes often reach 8 cm. in length by 1 mm. in diameter. The densely-leaved lateral shoots and tips of the main shoots with narrow linear spreading recurved leaves often give a very graceful plumose habit. to the plant; in the laxer specimens the leaves are generally longer, weaker, and less recurved.

A more delicate plant, bright green in colour, with almost filiform internodes (about 1·5 cm. long by ·5 mm. diameter in the middle of the shoot) and small, narrow, weak, recurving leaves, comes from Gwalior, Northern India.

The long thread-like roots are reddish-brown in the plants which have become established near Manchester.

Leaves from 1·5 to 2·5 cm. long by 4 to 6 mm. in width. *Sheaths* from 2·5 to 3·25 cm. long, including the auricle (1 to 1·75 mm.); the latter bears a few rather small teeth on both inner and outer edge, about 10 altogether. Intravaginal scales ·75 to 1 mm. long. Marginal teeth 30 to 50 in number, consisting of a sharp ascending spine supported by two generally but slightly projecting epidermal cells.

Below the epidermis runs a single row of long, narrow, colourless, supporting cells ("libriform cells"); these are absent in some Egyptian and Syrian specimens and in the plants found near Manchester, which Magnus has separated as the variety *Delilei*. As, however, these specimens can be distinguished by no other character, their habit, leaf-sheaths, marginal teeth, flowers, fruits, and seeds conforming to those of the type, which moreover grows in the same area, I have ventured to disregard the variety.

Flowers borne on the short lateral shoots, often several at the same node. From the dried material at command it is impossible to make general statements as to their relations, but in fresh specimens from the locality near Manchester no flowers were found in the axils of the two lowest pairs of leaves of the fertile shoot, the fertile (lower) leaf of the next higher pair sheathed a reduced shoot with several (4) female flowers, and that of each succeeding pair a reduced shoot consisting of a male and female flower standing side by side.

Male flowers before dehiscence of anther about 1 mm. long; perianth ending directly above the anther in two rounded ear-like lobes, which may be somewhat oblique; in the living specimens from Manchester they were tinged at the edge with red; anther oblong or oval-oblong. The flower-stalk elongates before dehiscence, becoming almost as long as the anther; the apical lobes of the perianth separate to allow the pollen to escape. Pollen dimorphic, grains larger and oblong and smaller and roundish, the latter with denser contents. *Female flowers* 1·3 to 1·6 mm. long. *Fruits* solitary or 2 to 4 crowded together at the base of the dwarf shoots; narrowly oblong or narrowly ellipsoidal or ellipsoidal-oblong, tapering more at the tip, in the fresh specimens greenish-

brown with a succulent pericarp; in the dried, the pericarp is very thin and membranous, peeling from the yellowish-brown seed. *Seed* 1·75 to 2·25 mm. long. *Testa* more or less distinctly marked with 25 to 30 more or less regular rows of small areolæ, which are subquadrate about the midle of the seed, but become irregularly 5- to 6-angular towards the ends and the prominent raphe.

Generally distributed throughout the warmer parts of the Old World. I have seen the following specimens:—

EUROPE—North Italy (probably introduced); England, Reddish Canal (var. *Delilei*, Magnus), near Manchester (introd.). Fossil seed in pleistocene bed at West Wittering, Sussex (*Reid*).

EGYPT—Kafr-es-Sayad (*Schweinfurth*); Cairo (*Schweinfurth*, no. 1712); Damietta and Mensaleh (*Schweinfurth*, var. *Delilei*, Magnus); Libyan desert, Oasis of Dakhel (*Rohlfs*, no. 2264).

NUBIA—Djur-land, "Grosse Seriba Ghattas" (*Schweinfurth*, no. 2140 in part).

ABYSSINIA—(*Steudner*, no. 213).

EAST TROPICAL AFRICA—East Ongalea Mts. (*Gregory*).

ARABIA, SOUTH-EAST—(*Bent*, no. 217).

SOCOTRA—(*Balfour*, no. 731).

PERSIA—Susan (*Haussknecht*, It. Orient. 1868).

INDIA—North-west India (? *Royle*); Gwalior (*Maries*, no. 391); Chittagong (*Hook. f. & Thoms.*); Calcutta (*Clarke*, no. 3944); Berhampur (*McClelland*); East Bengal (*Hook. f. & Thoms.*); Bengal (*Griffith*, no. 5609/2); Serampore (*Griffith*, no. 5609/3); Madras (*Wight*); Ceylon (*Martens*); Assam (*Jenkins*).

MALAYA—Pahang, Pekan (*Ridley*); Java (*Junghuhn*); Amboina (*Miquel*); Celebes (*Miquel*); Minahutta (*Savinierre*, no. 503); Philippines, Island of Mactan (*Moseley*); Molucca (*Blume*); Menado Tondano (*Teysmann*, no. 5314).

CHINA—Hongkong (*Wright*, no. 511).

JAPAN—(*Wichura*, no. 814); Nippon, Yokohama (*Maximowicz*), Akita (*Faurie*, no. 13775), Mouoka (?) (*Faurie*, no. 13920); Kiusiu, Nagasaki (*Oldham*, no. 823).

AUSTRALIA—North-west, mainland by Dampier Archipelago (*Naumann*); Brisbane river.

? S. AMERICA—Brazil (*Wallis*). ? Introduced or perhaps a mistake; see K. Schumann in Mart. Fl. Bras. iii. pt. 3, 732 (1894).

Var. MINOR, var. nov.

Planta minor, debilis, diffusa, cum foliis brevioribus, vaginis brevius auriculatis, et floribus ac fructu minoribus.

Specimens, when dried, forming a tangled mass of slender or filiform branching shoots, with limp, often clinging leaves. Width of internodes scarcely exceeding ·3 mm., often less; length 1 cm. or less. *Leaves* from 7 to 16 mm. long by ·15 to ·25 mm. broad, plane, libriform supporting cells absent, marginal teeth numerous (generally 20 to 30), small, raised slightly above the margin to about one-fifth the leaf-width in length; sheath narrow, in full-grown leaves about 1·5 mm. long by 1·25 broad when opened out, with

rounded or bluntish auricles one-fifth to one-sixth its length, bearing a few (5 to 7) spines, especially on the outer edge. Intravaginal scales narrow linear, tapering, scarcely ·5 mm long. *Male flower* before elongation ·6 mm. long; female 1 mm. long. *Seed* ellipsoidal-oblong, 1·15 to 1·5 mm. long, plainly marked with 20 to 25 rows of areolæ, which are more or less quadrate about the middle, becoming 5- to 6-gonal and less regular towards the ends.

INDIA—Bengal (*Griffith*, no. 5609/6).

BURMAH—(*Griffith*, no. 5609/1, in part); Pegu (*Kurz*, nos. 3192, 3310).

Var. ANGUSTIFOLIA, var. nov. (Pl. XLII. fig. 202.)

Planta debilis, foliis quam in specie angustioribus, apice subsetaceis, denticulis marginalibus magis conspicuis; fructu minore.

Habit weak, effuse; leaves (when dried) flexuose, generally 1·5 to 2 cm. long and ·2 to ·3 mm. broad; spines raised on shallow triangular outgrowths of the margin, forming teeth distinguishable by the naked eye, and on the narrower leaves reaching one-fourth to one-third the leaf-width. *Seed* scarcely exceeding 1 mm. long, closely resembling that of var. *minor*, but smaller.

MALAYA—Singapore, Garden Lake (*Ridley*, no. 8916); Borneo, Bangarmassing (*Motley*).

The Bornean plant has rather shorter leaves (scarcely 1·5 cm. long) and somewhat more prominently denticulate leaf-teeth than the specimen from Singapore, but the seeds conform.

Species dubiæ vel excludendæ.

Najas microphylla, Reichb. Fl. Germ. Excurs. 843 (1832) = *Caulinia mycrophylla*, Nocca & Balb.

Najas? *obvoluta*, Blanco, Fl. Filip. [ed. 2] 460 (1845), ib. (Naves) gran. ed. iii. 66 (1879).

"Caulis erectus, bipalmaris, ad digitum grossus, supra planus, infra rotundo-striatus. Folia alterna, alata, alte plurilobulata, lobulis subulatis rotundisque, aut potius convoluta, 5- vel pluri-secta. Flores monoici," &c.

In *op. cit.* (gran. ed.) Nov. App. 332 (1880) this is placed as a synonym of a fern, ***Ceratopteris thalictroides***, Brongn.

Najas palustris, Blanco, Fl. Filip. 660 (1837); Kunth, Enum. iii. 590 (1841).

N. lobata, Blanco, Fl. Filip. [ed. 2] 459 (1845), ib. (Naves) gran. ed. iii. 65 (1879). The description in Fl. Filip. [ed. 2] 459 is word for word that of *N. palustris* in the first edition. The only change is in the specific name.

"Caulis rotundus, ramosus. Folia alterna, linearia, margine denticulata, basi obtuse biauriculata, auriculis amplexicaulibus. Ramusculi axillares foliis alternis vere aucti; ideoque folia semper alterna. Flores monoici, pauci, notabiles. Masculi axillares, solitarii, involucello spathæformi, monophyllo, lateraliter dehiscente instructi. Cal. involucellum superans, cylindricus, limbo in 2 labia ovata et divergentia diviso. Stam. 1, filam. crasso. Anth. 1, calycis fauce brevior,

subsagitta marginibus subrevolutis. Feminæ solitariæ, axillares, involucello ut in masculis. Cal. 0. Ovar. ovale. Styl. 2. Fructus vesicæformis, indehiscens, substantiâ farinaceâ et aquosâ fœtus."

"Planta calyce gracili, albo, semilineari, in lacustribus crescens. Flor. mens. Mart."

Plant not seen, but the markedly alternate leaves and structure of the male flower are incompatible with anything known of the genus.

Najas rigida, Griff. Not. iii. 181 (1851).

"Foliis carnosis rigidis (e tela composita cellulosa), alternis, interspatiis concavis. Pistil. perianthio tubuloso apice spiculigero inclus.

Hab. "in aquis stagnantibus Serampore." "Colour blackish green."

The presence of a perianth in the female flower points to *N. indica* (the only Indian species of the section Spathaceæ), but the fleshy rigid leaves do not accord, and alternate leaves are incompatible with the genus as at present understood.

Najas tenuifolia, Naves & F. Vill. in Blanco, Fl. Filip. Nov. App. 297 (1880), non R. Br. = *N. palustris*, Blanco.

Caulinia ? *composita*, Buch.-Ham. ex Wall. List, no. 5184 = *Ceratophyllum.*

Caulinia microphylla, Nocca & Balb. Fl. Ticin. ii. 163, t. 16 (1821), is probably *Ceratophyllum demersum*, Linn.

List of Species and Synonyms.

Caulinia alagnensis, Poll. = Najas graminea.
C. alternifolia, Willd. = N. australis.
C. composita, Buch.-Ham. = Ceratophyllum.
C. flexilis, Willd. = N. flexilis.
C. fragilis, Pursh = N. flexilis.
C. fragilis, Willd. = N. minor.
C. gracilis, Pouzolz = N. minor.
C. guadalupensis, Spreng. = N. microdon.
C. indica, Willd. = N. indica.
C. indica, Wall. List = N. minor.
C. intermedia, Balb. = N. graminea.
C. minor, Coss. & Germ. = N. minor.
C. muricata, Spreng. = N. marina var.
C. microphylla, Nocca & Balb. = Ceratophyllum.
C. pectinata, Parl. = N. horrida.
C. tenella, T. Nees = N. arguta.
Fluvialis flexilis, Pers. = N. flexilis.
F. indica, Pers. = N. indica.
F. minor, Pers. = N. minor.
Ittnera major, Reichb. = N. marina.
I. minor, C. C. Gmel. = N. minor.
I. Najas, C. C. Gmel. = N. marina.

Najas alagnensis, Paglia = N. minor.
N. alagnensis, Poll. = N. graminea.
N. ancistrocarpa, A. Br.
N. arguta, H. B. K.
—— var. *conferta*, A. Br. = N. conferta.
—— var. *tenera*, A. Br. = N. arguta.
N. australis, Bory.
N. brevistyla, Rendle.
N. Browniana, Rendle.
N. canadensis, Michx. = N. flexilis.
N. conferta, A. Br.
N. dichotoma, Roxb. = N. minor.
N. falciculata, A. Br.
N. flexilis, Griseb. (in part) = N. microdon.
N. flexilis, Griseb. (in part) = N. Wrightiana.
N. flexilis, Rostk. & Schmidt.
—— var. *curassavica*, A. Br. = N. microdon var.
—— var. *fusiformis*, Chapm. = N. microdon.
—— var. *Gollmeriana*, A. Br. = N. microdon, var. curassavica.
—— var. *guadalupensis*, A. Br. = N. microdon.
—— var. microcarpa, Nilss.

N. flexilis, var. *punctata*, A. Br. = N. punctata.
—— var. robusta, Morong.
N. fluvialis, Thuill. = N. marina.
N. fluviatilis, Poir. = N. marina.
N. foveolata, A. Br.
N. foveolata, var. minor, Rendle.
N. fragilis, Delile = N. minor.
N. fragilis, Rostk. & Schm. = N. minor.
N. fucoides, Griff. = N. marina.
N. gracillima, Magnus.
N. graminea, Delile.
—— var. angustifolia, Rendle.
—— var. *Delilei*, Magn. = N. graminea.
—— var. minor, Rendle.
—— var. *tenuifolia*, A. Br. = N. tenuifolia.
—— var. *vulgata*, Magnus = N. graminea.
N. graminea, Rostk. = N. flexilis.
N. guadalupensis, Morong = N. microdon.
N. heteromorpha, Griff. = N. minor.
N. horrida, A. Br.
N. indica, Cham.
—— var. gracillima, A. Br. = N. gracillima.
N. indica, Griff. = N. indica?
N. indica, Wall. = N. minor.
N. indica, Zoll. = N. foveolata.
N. intermedia, Gorsk. = N. marina var.
N. interrupta, K. Schum.
N. Kingii, Rendle.
N. Kurziana, Rendle.
N. lacerata, Rendle.
N. latifolia, A. Br. = N. marina var.
N. latior, F. Muell. = N. marina.
N. Leichhardtii, Magnus.
N. lobata, Blanco = N. palustris.
N. madagascariensis, Rendle.
N. major, All. = N. marina.
—— var. *lævis*, DC. = N. marina.
—— var. *multidentata*, A. Br. = N. marina.
—— var. *paucidentata*, A. Br. = N. marina.
—— var. *spinulosa*, DC. = N. marina.
N. marina, Linn.
—— var. angustifolia, A. Br.
—— var. *angustissima*, K. Schum. = var. gracilis.
—— var. *Bollei*, K. Schum. = var. microcarpa.
—— var. brevifolia, Rendle.
—— var. californica, Rendle.
—— var. Ehrenbergii, A. Br.
N. marina, var. *genuina*, K. Schum. = var. intermedia.
—— var. gracilis, Morong.
—— var. grossedentata, Rendle.
—— var. intermedia, A. Br.
—— var. latifolia, A. Br.
—— var. *latior*, F. Muell. = N. marina.
—— var. mexicana, Rendle.
—— var. microcarpa, A. Br.
—— var. *muricata*, Hartm. = N. marina.
N. marina, Linn., var. muricata, A. Br.
—— var. recurvata, Dudl.
—— var. Riedelii, K. Schum.
N. maritima, Pall. = N. marina, var. intermedia.
N. marina, Linn. Fl. Suec., in part = N. minor.
N. microcarpa, K. Schum.
N. microdon, A. Br.
—— var. curassavica, A. Br.
—— var. *guadalupensis*, A. Br. = N. microdon.
N. microphylla, Reichb. = Caulinia microphylla.
N. minor, All.
—— var. *indica*, A. Br. in part = N. australis.
„ „ = N. indica.
—— var. *intermedia*, Cesati = N. minor.
—— var. *setacea*, A. Br. = N. setacea.
—— var. spinosa, Rendle.
—— var. *tenuissima*, A. Br. = N. tenuissima.
N. monosperma, Willd. = N. marina.
N. muricata, Delile = N. marina var.
N. muricata, Thuill. = N. marina.
N. ? obvoluta, Blanco = Ceratopteris.
N. palustris, Blanco = sp. dub.
N. pectinata, Magnus = N. horrida.
N. pluvialis, K. Schum. = N. marina.
N. podostemon, Magnus.
N. polonica, Zalewski = N. marina.
N. punctata, Rendle.
N. rigida, Griff. = sp. dub.
N. Schweinfurthii, Magnus.
N. seminuda, Griff. = N. graminea.
N. serratistipula, Magnus = N. graminea.
N. serristipula, Maxim. = N. graminea.
N. setacea, Rendle.
N. spinosa, Buch.-Ham. = N. marina.
N. subulata, Thuill. = N. minor.
N. tenera, Schrad. = N. arguta.
N. tenuifolia, Aschers. = N. graminea.
N. tenuifolia, R. Br.

N. tenuifolia, Naves & F. Vill.=N. palustris.
N. tenuis, A. Br.=N. indica.
N. tenuissima, A. Br.
N. ternata, Roxb. ex Griff.=N. minor?
N. tetrasperma, Willd.=N. marina.
N. valisnerioides, Griff.=N. graminea.
N. Welwitschii, Rendle.
N. Wrightiana, A. Br.
—— var. laxa, A. Br.
Sclerocarpus obliquus, C. A. Weber=N. marina.

EXPLANATION OF THE PLATES.

a, anther; *p*, perianth; *pe*, pedicel; *s*, spathe; *st*, stigma; *v*, leaf-sheath.

Plate XXXIX.

Najas marina. (Figs. 1 to 30.)

1. Young ovary with three stigmas, the ovule directed horizontally. × 15.
2. ,, ,, with two stigmas, slightly older than in fig. 1, with almost anatropous ovule. × 12.
3. Ovary ready for pollination. × 12. One stigma appreciably shorter than the other two.
4. Ovary after fertilization. × 9.
5. Male flower protruding from leaf-sheath. × 6.
6. ,, ,, after removal of spathe. × 6.
7. ,, ,, ,, ,, perianth, showing the four-celled anther. × 6.
8. Intravaginal scales. × 20.
9. Leaf of var. *recurvata*. × 2. Specimen from Buffalo (*Clinton*).
10. ,, var. *Ehrenbergii*. × 2. ,, ,, Arabia (*Ehrenberg*).
11. ,, var. *latifolia*. × 2. ,, ,, Caracas (*Gollmer*).
12. ,, var. *muricata*. × 3. ,, ,, Damietta (*Sieber*).
13. ,, var. *angustifolia*. × 2. ,, ,, Oahu (*Menzies*).
14. ,, var. *intermedia*. × 3. ,, ,, Prussia (*Caspary*).
15. ,, var. *californica*. × 2½. ,, ,, California (*Orcutt*).
16. Tip of shoot of var. *grossedentata*. × 2. Specimen from China (*Staunton*).
17. Seed of *N. marina* form *α* from Polish specimen (*Woloszczak*). × 8.
18. ,, ,, ,, ,, Japanese specimen (*Maximowicz*). × 7.
19. ,, ,, ,, *β* from specimen from Paris (*Brongniart*). × 7.
20. ,, ,, ,, ,, ,, ,, ,, Germany (*Muench.*).
21. Fossil seed from Cromer forest-bed (preglacial), side view. (From sketch supplied by Mr. Reid.)
22. Portion of testa of same much enlarged. Do.
23. Fossil seed from Cromer forest-bed, front view. Do.
24. Portion of testa of recent seed. Much enlarged.
25. Seed of *N. marina* form *γ* from Cashmere (*Young*). × 7.
26. ,, ,, var. *recurvata*. × 7.
27. ,, ,, var. *Ehrenbergii*. × 7.
28. ,, ,, var. *angustifolia*. × 7.
29. ,, ,, var. *intermedia*. × 7.
30. ,, ,, var. *mexicana*. × 7.

Najas indica. (Figs. 31 to 45.)

31. Side view of leaf-sheath. × 20. From type-specimen of *Caulinia indica*, Willd. in Herb. Berlin.
32. Leaf-apex from same specimen. × 30.

33. Portion of a leaf-blade from same specimen. × 20.
34–37. To show variation in form of leaf-sheath. × 20. 34, 35 from opposite leaves; 36 from a leaf a little higher on the same shoot (specimen in Herb. Link.); 37 from a different plant (Tranquebar, *Klein*).
38. Intravaginal scale. × 40.
39. Young male flower. × 30. Specimen from Tranquebar.
40. Mature „ × 15. „ „
41. Male flower showing enlarged pedicel, laterally split spathe, and rolling back of perianth-lobes. × 10. Specimen from Tranquebar.
42. Pollen from same flower. Much enlarged.
43. Female flower showing one stigma protruding from mouth of spathe. × 20. Specimen from Tranquebar.
44. Same as fig. 43 after removal of spathe. × 30.
45. Seed. × 15. Specimen from Tranquebar.

Najas Welwitschii. (Figs. 46 to 54.)

46. Front view of leaf-sheath. × 20.
47. Apex of leaf. × 15.
48. Intravaginal scale. × 15.
49. Marginal leaf-tooth. Much enlarged.
50. Male flower. × 20.
51. „ showing elongation of pedicel (*pe*) and rupture of spathe (*s*). × 12.
52. Female flower; the two stigmas (*st*) protrude from the mouth of the spathe (*s*). × 30.

Plate XL.

53. Seed. × 10.
54. Markings on seed-coat. Much enlarged.

Najas madagascariensis. (Figs. 55 to 63.)

55. Side view of leaf-sheath with rounded shoulders. × 14.
56. Leaf-sheath with auricled shoulders. × 10.
57. Young male flower. × 30.
58. Mature „ × 16.
59. Female flower. × 22.
60. The same after fertilization. × 12.
61. Tip of same flower as in fig. 60 after removal of spathe, showing the two stigmas under somewhat higher magnification.
62. Seed. × 5.
63. Lower part of seed more highly magnified to show markings on seed-coat. × 35.

Najas Schweinfurthii. (Figs. 64 to 67.)

64. Front view of leaf-sheath. × 40.
65. Scarcely mature male flower. × 50.
66. Male flower, showing anther-dehiscence. × 12.
67. Female flower. × 30.

Najas Wrightiana. (Figs. 68 to 74.)

68. Front view of leaf-sheath. × 10. Specimen from Pernambuco (*Ridley*).
69. Male flower. × 30. Specimen from Cuba (*Wright*).
70. Female flower. × 18. „ „

71. Base of leaf a' subtending two female flowers (see diagram, fig. 72); x, intravaginal scale. × 15 Specimen from Cuba (*Wright*).

72. Diagram of arrangement of leaves and flowers in fig. 71. a, b, pair of leaves at a node; a, fertile leaf; b, barren leaf; (1), basal flower, a', first leaf on branch in axil of a; (2), basal flower, and a'', first leaf on lowest branch of the axillary shoot.

73. Intravaginal scale. × 30. Specimen from Cuba (*Wright*).

74. Seed. × 25. Specimen from Pernambuco (*Ridley*).

Najas conferta. (Figs. 75 to 77.)

75. Leaf. × 4. From Brazilian specimen (*Neuwied*) in Herb. A. Braun.

76. Seed. × 15. From Cuban specimen in the same collection.

77. Markings on seed-coat. Much enlarged.

Najas microdon. (Figs. 78 to 91.)

78. Leaf-sheath, front view. × 10. Specimen from Guadeloupe (*Duchassaing*).

79. Marginal leaf-tooth from same specimen. Much enlarged.

80. Male flower. × 28. Specimen from Cuba (*Wright*).

81. Transverse section of ditto, showing the four anther-cells. × 30.

82. Very young female flower. Specimen from Mexico (*Schaffner*).

83–90. Series showing variation in form and number of stigmas and spine-arms.
83 to 87 from a single plant (Mexico, *Hahn*).

83. Three stigmas, one of which bears a spine.

84. Two perfect stigmas and a third which passes into a spine-arm.

85. ,, ,, ,, and a perfect spine-arm.

86. One simple stigma and a second branching, the branches bearing spines.

87. Three spine-tipped stigmas.

88. Two perfect stigmas only. Specimen from Mexico (*Mueller*).

89. Normal flower with decussating pairs of stigmas and spine-arms. × 30. Specimen from Guadeloupe (*Duchassaing*).

90. Flower with three long stigmas only. × 35. Specimen from Jamaica (*Swartz*).

91. Fruit. × 20. Specimen from Mexico (*Hahn*).

Najas flexilis. (Figs. 92 to 98.)

92. Male flower, young. × 30. Irish specimen.

93. ,, spathe removed. ,,

94. ,, showing lateral rupture of spathe by elongation of pedicel, and dehiscence of anther. Specimen from Washington, D.C.

95. Pollen-grain. Highly magnified.

96. Seed. × 8. Specimen from New York (*Torrey*).

97. ,, ,, ,, ,, Eastern United States (*Nuttall*).

98. Markings seen through the polished outer layer of seed-coat. Much enlarged.

Najas punctata. (Figs. 99 to 102.)

99. Small portion of leaf-margin, showing spine-teeth and hypodermal fibres.

100. Intravaginal scales. × 20.

101. Transverse section of anther, showing arrangement of the four cells.

102. Female flower, showing two stigmas and a spine-arm. × 27.

Najas arguta. (Figs. 103, 104.)

103. Leaf. Natural size.
104. Marginal leaf-tooth. Much enlarged.

Plate XLI.

Najas minor. (Figs. 105 to 115.)

105 to 107. Forms of sheath-leaves: side view.

105. From a specimen from Berlin. × 10.
106. From a French specimen. × 8.
107. From a Portuguese specimen (*Welwitsch*, no. 410). × 10.
108. Male flower. × 30.
109. „ „ with spathe removed. More highly magnified.
110. „ „ „ „ „ and perianth slit and drawn back.
111. Pollen-grains. Highly magnified.
112. Elongation of pedicel preceding dehiscence of anther. × 30.
113. Young female flower. × 25.
114. Seed. × 12.
115. Fossil seed from pleistocene, West Wittering, Sussex (*Reid*). × 12.

Najas Kurziana. (Figs. 116 to 121.)

116. Leaf-sheath. × 30.
117. Intravaginal scale. × 50.
118. Single tooth on leaf-margin. Highly magnified.
119. Male flower. × 50.
120. „ „ showing anther-dehiscence. × 60.
121. Seed. × 30.

Najas gracillima. (Figs. 122 to 125.)

122. Leaf-sheath and fruit. × 20.
123. Marginal leaf-tooth. Highly magnified.
124. Male flower. × 30.
125. Pollen-grains. Highly magnified.

Najas Kingii. (Figs. 126 to 131.)

126. Leaf-sheath and base of blade. × 20.
127. Intravaginal scale. × 40.
128. Marginal tooth of blade. Highly magnified.
129. Female flower. × 40.
130. Seed. × 12.
131. Small portion of surface view of testa. Highly magnified.

Najas lacerata. (Figs. 132 to 138.)

132. Leaf-sheath and base of blade. × 30.
133. Intravaginal scale. × 30.
134. Apex of leaf. × 40.

135. Marginal tooth of blade. Highly magnified.
136. Back view of portion of blade, showing dorsal teeth. Enlarged.
137 Portion of transverse section of stem, showing epidermis, starch-containing cortex with large intercellular spaces, and central stele. The last consists of small-celled tissue with a few larger cells at irregular intervals, surrounding a central intercellular space. × 80.
138. Male flower. × 25.

Najas foveolata. (Figs. 139 to 144.)

139. One-half of an opened leaf-sheath. × 10.
140. Apex of leaf. × 10.
141. Young male flower in position, with leaf-bases thrust aside. × 12.
142. Male flower after anther-dehiscence (var. *minor*). × 12.
143. Seed. × 18.
144. Transverse section of fragment of testa. Highly magnified. Showing the three layers; an outer one of large thin-walled cells with delicate spiral thickenings, a median layer of very thick-walled pitted cells, and an inner layer of tangentially compressed, moderately thickened cells.

Plate XLII.

Najas falciculata. (Figs. 145 to 151.)

145. Leaf-sheath opened, with base of blade. × 20.
146. Intravaginal scale. × 30.
147. Tip of leaf. × 40.
148. Marginal tooth of blade. Highly magnified.
149. Transverse section of stem. Highly magnified. An inner row of small cells of the stele surrounding the central space has been omitted. × 70. (From a specimen collected by Martens at Manila.)
150. Transverse section of leaf. × 70. (From same specimen as fig. 149.)
151. Seed. × 20.

Najas brevistyla. (Figs. 152 to 157.)

152. Portion of leaf-blade. × 40.
153. Intravaginal scale. × 20.
154. Male flower. × 35.
155. Pollen-grains. Highly magnified.
156. Female flower. × 35.
157. Seed. × 30.

Najas tenuifolia. (Figs. 158 to 162.)

158. One side of leaf-sheath. × 30.
159. Small portion of leaf-margin. Much enlarged. Showing tooth and thick hypodermal supporting fibre.
160. Male flower. × 9.
161. Female flower. × 30.
162. Seed. × 17. The conspicuous narrowing at the base shown in the figure is unusual.

Najas Browniana. (Figs. 163 to 167.)

163. One side of leaf-sheath. × 24.
164. Small portion of leaf-margin, showing projecting spine-cell. Much enlarged.

165. Young male flower. × 70.
166. Female flower with scale. × 30.
167. Seed. × 20.

Najas Leichhardtii. (Figs. 168 to 171.)

168. Leaf-sheath: side view. × 20.
169. Small portion of leaf-blade. × 20.
170. Apex of male flower, showing neck of sheath (*s*), and tip of perianth (*p*). × 24.
171. Female flower. × 24.

Najas australis. (Figs. 172 to 176.)

172. Upper part of leaf-sheath opened. × 6.
173. Portion of blade. × 20.
174. Female flower. × 20.
175. Fruit. × 18.
176. Markings on surface of testa. Much enlarged.

Najas setacea. (Figs. 177 to 182.)

177. Leaf-sheath. × 25.
178. Intravaginal scale. × 30?
179. Apex of leaf. × 50.
180. Portion of leaf-margin, showing two spine-teeth. Much enlarged.
181. Female flower. × 30.
182. Seed. × 15.

Najas horrida. (Figs. 183 to 191.)

183. Base of blade with opened sheath. × 5. (Central African specimen collected by Schweinfurth.)
184. Side view of leaf-sheath, from same plant as fig. 183. × 5.
185. ,, ,, from plant collected at Mozambique by Schlechter. × 10.
186. Marginal leaf-tooth from Tanganyikan specimen (*Hore*). Much enlarged.
187. Transverse section of stem of same specimen as fig. 186. × 50. Showing (1) epidermal layer, (2) six to seven layers of starch-containing cortical cells with large intercellular spaces, and (3) central stele with axial air-canal. The structure of the stele is imperfectly shown in so small a sketch; it is by no means homogeneous, but consists of larger cells, more or less rounded in section, and irregular strands and masses of much smaller very thin-walled cells, multangular in section, and rich in proteid or protoplasm (presumably bast-tissue).
188. Young male flower. × 23.
189. Transverse section of mature male flower, showing cruciform arrangement of the four anther-cells. Much enlarged.
190. Female flower, after fertilization. × 20.
191. Seed. × 12.

Najas graminea. (Figs. 192 to 202.)

192. One side of opened leaf-sheath. × 12.
193. Portion of leaf-margin of specimen from Philippines (*Moseley*). Much enlarged.
194. ,, ,, ,, Abyssinia (*Steudner*). Much enlarged.
195. ,, ,, ,, Gwalior (*Maries*). Much enlarged.

196. Longitudinal section of apex of root, showing root-cap. × 30.
197. Male flower. × 25.
198. Pollen-grains, showing spherical and oblong forms. Much enlarged.
199. Female flower. × 12.
200. Seed. × 12.
201. Fossil seed from pleistocene, West Wittering, Sussex (*Reid*). × 12.
202. Seed of var. *angustifolia*. × 12.

Trans. Linn. Soc. Ser. 2. Bot. Vol. V. Pl. 43.

A. B. Rendle del.
E. Morgan lith.

Mintern Bros. imp.

SPECIES OF NAJAS.

SPECIES OF NAJAS.

A. B. Rendle del.
R. Morgan lith.

West Newman imp.

SPECIES OF NAJAS.

LINNEAN SOCIETY OF LONDON.

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THE

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OF

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BY

ALFRED BARTON RENDLE, M.A., D.Sc., F.L.S.

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XIII. *Supplementary Notes on the Genus* Najas. *By* ALFRED BARTON RENDLE, *M.A., D.Sc., F.L.S., Assistant in Botany, British Museum.*

Read 21st June, 1900.

SINCE the publication of my Revision of this genus (Trans. Linn. Soc. ser. 2, Bot. vol. v. pp. 379–436) I have had an opportunity of visiting a number of important continental Herbaria. I have worked through all the material which I could find of the genus in the following public and private collections:—at Paris, the National Herbarium in the Jardin des Plantes, and also the Herbaria of the late M. Cosson and M. Drake del Castillo; at Geneva, the Delessert Herbarium at the Botanic Gardens, the Boissier Herbarium, and the DeCandolle Herbarium; at Zurich, the Herbarium associated with the Botanic Gardens; at Vienna, the Herbarium at the Hofmuseum and the Herbarium associated with the Botanic Gardens; at Berlin, the Imperial Herbarium and also the private collections of Dr. Magnus. I take this opportunity of putting on record my obligations to the various gentlemen associated with these collections for their readiness to give me all the help possible and once more tender them my hearty thanks. I am also indebted to the authorities at the St. Petersburg Botanic Museum for a number of Russian and Central Asiatic specimens which Dr. Litwinow, the curator, has sent to the Department of Botany of the British Museum.

In the following notes I have included additional points of interest which I observed, both in geographical distribution and in the elucidation of varieties or species. I saw very few new forms, a circumstance which, though disappointing, argues for the comparative completeness of my monograph as representing what is known of the genus at the present time.

Subgenus 1. EUNAJAS, Aschers.

1. NAJAS MARINA, Linn. Sp. Pl. 1015 (1753); Rendle in Trans. Linn. Soc. ser. 2, Bot. v. 389 (1899).

I have the following notes on the distribution of the three forms under which I attempted to arrange the specimens in my revision:—

α. A luxuriant form. I have seen specimens from the following districts not previously noted:—

FRANCE—Saon and Loire; Bordeaux (*Baillet*).

SPAIN—Laguna de Dournos, Gallecia (*Lange*).

HUNGARY—Marchfeld (*Matz*).

SOUTH RUSSIA—Mouth of the Volga, River Algari (*Korshinsky*).

AUSTRALIA—Lake Muir and Nichol Bay, West Australia (*Mueller*).

β. The common European form. Additional localities :—

FRANCE—Seurre, Côte d'Or: Maine (*Bouret*), &c.

GERMANY—Lyck and Borono-See, Prussia; Parstein-See, Wesen-See, and numerous localities in province Brandenburg; River Schlei, Silesia; Lake Constance, near Wangen (*Ziegler*).

HUNGARY—Lake Balaton at Keszthely (*Borbas*).

RUSSIA—Lithuania (*Besser*); the following localities at the mouth of the Volga: Jablouka, Tandik, Czilikino, and Algari (*Korshinsky*).

SWITZERLAND—Lugano (*Schinz*).

ITALY—Venetia (*Rigo*); Palermo (*Ross*).

γ. A large-fruited form.

This form seems common in Switzerland and North Italy. I have notes of the following localities :—Lugano, Lake Maggiore, Lake Como, Lake Varese, Verona, Mantua, Lake Bientina.

The specimens from Lake Maggiore, collected by Magnus and others, approach the common form; they have the habit with the large patent teeth of the large-fruited form, but the fruit smaller than usual, scarcely 5 mm. long.

I have also seen specimens from :—

SOUTH RUSSIA—Mouth of the Volga, near Oli (*Korshinsky*), without fruit.

NORTH ASIA—Altai (*Politow* in Herb. Hort. Bot. Vindob.), a grossly dentate specimen with unripe fruit.

AMERICA—Arizona, Santa Cruz River (*Pringle*).

Var. DENTICULATA, var. nov.

Sublaxa, internodiis elongatis sparsissime et breviter spinosis; foliis linearibus, margine denticulatis, denticulis laminæ latitudine certe duplo brevioribus, vagina cum margine pauci- (1–3-) denticulata.

Branches ascending, about 20 cm. long, lower internodes 4 to 5 cm. long, 1 mm. in diameter, becoming gradually shorter above. *Leaves* ascendo-patent, 1·5 to 3 cm. long, 1 to 1·3 mm. broad, bearing a few (3 to 5) small dorsal spines and 6 to 12 shallow teeth on each margin, on the oldest leaves the teeth may equal half the leaf-width in length; sheaths broad, 3 to 4 mm. long. Female specimens only were seen; ovary with 3 stigmas; unripe fruit light brown, rather narrowly ellipsoidal, 3·5 mm. long by less than 1·5 mm. in diameter.

Has the habit of a small example of the luxuriant form of the species, differing, however, in its proportionately smaller marginal teeth.

CENTRAL ASIA—Semipalatinsk, River Ajaguz (*Korshinsky*).

Specimen communicated by the Botanic Museum of St. Petersburg.

Var. ZOLLINGERI, var. nov.

Planta luxurians, internodiis inermibus; foliis linearibus, planis, subacutis, marginibus cum dentibus parvis frequentibus instructis, dorso inermi; fructu mediocri.

Stems spreading, with short densely leaved branches. *Leaves* 3 to 4·5 cm. long by 2 to 2·5 mm. broad, with 12 to 15 marginal teeth on each side, $\frac{1}{8}$ to $\frac{1}{5}$ the leaf-width

in length; sheaths 3 mm. long, with few (2 to 3) or no small shallow teeth on the broadly rounded shoulders. *Flowers* not seen. *Fruit* rare, 4 mm. long by 1·6 mm. broad.

Resembles the luxuriant form of the type, but differs in the smaller marginal leaf-teeth and smaller fruit.

MALAY ARCHIPELAGO—Bali Island, "In laculo (Danu) Bator, 3230'." Sept. 8, 1857. (*Zollinger*, no. 3891, in Herb. Mus. Palat. Vindob.)

It also approaches the Socotran specimen of the var. *Ehrenbergii*, but has longer, narrower, and more acute leaves; the fruit is also larger than observed in that variety.

Var. ANGUSTIFOLIA, A. Br. in Journ. Bot. ii. 1864, 275; Rendle in Trans. Linn. Soc. ser. 2, Bot. v. 394 (1899).

The following specimens indicate a wider distribution than previously given:—

CASPIAN SEA—(Herb. Bunge in Herb. Cosson).

WEST AUSTRALIA—Murchison River (*Oldfield*).

Var. INTERMEDIA, A. Br. in Journ. Bot. ii. 1864, 276; Rendle in Trans. Linn. Soc. ser. 2, Bot. v. 395 (1899).

Besides specimens from additional localities in the Baltic area and North Germany, I have seen the following, by which the range of the variety is somewhat extended:—

SOUTH AUSTRIA—Klagenfurt "Am Schiffahrtscanal von Worther-See" (*Melling* in Herb. Magnus).

RUSSIA—Lithuania (*Gorski* in Herb. Mus. Palat. Vindob., the type of *N. intermedia*, Gorski).

SICILY—(*Ross* in Herb. Magnus).

INDIA—Khandura District, Central Provinces (*Duthie*, no. 8549 in part).

I saw a fine form with lower internodes 10 cm. long by 1·75 mm. broad, and leaves reaching 3 cm. in length by 1 mm. broad (fruit barely 4 mm. long), from Sudermannia (*Ekström* in Herb. Hort. Bot. Zurich).

Var. BRACHYCARPA, Trautv. in Bull. Soc. Imp. Mosc. xl. no. iii. (1867) 97.

Planta caulibus inermibus, foliis brevibus, linearibus, obtusis, marginibus denticulatis, vaginis latis; fructu minore, ellipsoideo.

Branches rigidulous, laxly leaved, ascending, lower internodes 3 to 4 cm. long, becoming gradually shorter above, 1 mm. or less in width. *Lower leaves* 12 to 16 mm. long, including the large sheath, by 1 to 1·25 mm. broad, bearing 5 to 8 shallowly patent marginal teeth, which are about one-fourth the leaf-width in length; the leaves become shorter as we ascend the stem, the upper ones being barely 5 mm. long, including the sheath (2 mm.), and less than 1 mm. broad, with only 3 marginal teeth; sheaths with 1 or 2 shallow teeth on the broad shoulder, often broader than long; in the lower leaves about 3 mm. long by 3·5 to 4 mm. broad. *Fruit* broadly ellipsoidal, obtuse, 2·5 mm. long by 1·75 mm. broad; seed dark brown.

Approaches var. *intermedia*, A. Br., especially in habit, but is distinguished by the broader less prominently toothed leaves and the smaller broader fruit.

CENTRAL ASIA—Lake Alakul, Songaria (*Schrenk*).

I am indebted to the Botanical Museum of St. Petersburg for specimens of this variety, which I had previously overlooked. I have given a description, as the original diagnosis, " fructu minore, ellipsoideo," conveys very little information.

Var. MURICATA, A. Br. ex K. Schum. in Mart. Fl. Bras. iii. pt. 3, 725 (1894); Rendle in Trans. Linn. Soc. ser. 2, Bot. v. 397 (1899).

I have seen the following specimens by which the range of the variety is much extended beyond that given in my revision (Lower Egypt, Ceylon):—

SICILY—Palermo (*Ross* in Herb. Magnus).

ALGERIA—Oued (river) Boudouaou and Oued Reghaia (*Battandier* in Herb. Cosson); Magroun Cherchara (*Letourneux* in Herb. Cosson).

EGYPT—Lake Mareotis (*Letourneux* in Herb. Cosson); Medinet-el-Fajum (*Schweinfurth*, no. 114).

EAST TROPICAL AFRICA—Albert Nyassa (*Stuhlmann*, no. 2841, in Herb. Schweinfurth).

CENTRAL AUSTRALIA—Finke River (*Kempe* in Herb. Hort. Bot. Vindob.).

Battandier's specimen from Algeria is not quite typical, having shorter leaves than usual, 1 cm. long, with only 3 to 4 spines on each side. The Albert Nyassa plant is more robust than any I have seen, with leaves often 1·5 mm. in breadth. The Australian specimen differs from the Egyptian and Ceylon plants in having rather longer leaves, which may reach 2·5 or even 3 cm. long, and slightly smaller fruit, barely 3 mm. long by 2 mm. broad.

The variety has evidently a wide range in the tropics of the Old World and will doubtless be found in many other localities.

Subgenus 2. CAULINIA, A. Br.

§ 1. *Spathaceæ.*

4*. NAJAS AFFINIS, sp. nov.

Herba caulibus tenuibus; *internodiis* sub apice ramulorum congestorum admodum abbreviatis et cum foliis recurvatis habitum *N. minoris* præbentibus; *foliis* patentibus, planis, linearibus, margine cum dentibus parvis numerosis regulariter instructis; *vaginis* late rotundatis, margine breviter fimbriatis; squamulis intravaginalibus lanceolatis; *floribus* solitariis; *spatha mascula* ellipsoidea, collo longo, tenuiter cylindrico, ore spinifero, anthera quadriloculari; *spathæ fœmineæ* collo superne in limbis linearibus binis oppositis unispiniferis elongato; *fructu* . . . . .

Shoots to 30 cm. long, lower internodes 5 to 5·5 cm. long by ·75 mm. broad. *Leaves* 1·5 to 2 cm. long by ·5 to ·7 mm. broad, teeth 12 to 18 on each margin, one-fourth of the leaf-width in length; sheaths 2 mm. long and broad, upper margin and shoulders irregularly broken into short narrow outgrowths tipped with spine-cells, the outgrowths may extend almost to the base of the sheath; intravaginal scales ·75 mm. long. *Male flower* 2 mm. long including the neck of the spathe; *female*, apparently not quite mature, 1·5 mm. long, spathe ellipsoidal with a cylindrical neck passing above into a pair of long narrow spine-tipped outgrowths overtopping the two stigmas.

Closely allied to *N. Welwitschii*, Rendle, from which it is distinguished by a less lax habit, the tuft-like densely leaved terminal branchlets, the more regularly toothed

spreading firmer leaves, fimbriate leaf-sheath, and the pair of terminal outgrowths on the female spathe.

Described from a plant in Herb. Cosson (Paris), collected by Leprieur; no locality is given, but it is doubtless from Senegal.

5. NAJAS MADAGASCARIENSIS, Rendle in Trans. Linn. Soc. ser. 2, Bot. v. 402 (1899).

The following extends the range of this species, hitherto known only from Madagascar:—

MAURITIUS—River Moha (*H. H. Johnston*).

BOURBON—St. Benoit (*De l'Isle*, no. 563), St. Paul (*De l'Isle*, no. 141), both in Herb. Cosson (Paris).

§ 2. *Americanæ.*

7. NAJAS FLEXILIS, Rostk. & Schm. Fl. Sedin. 382 (1824); Rendle in Trans. Linn. Soc. ser. 2, Bot. v. 403 (1899).

I have noted the following additional localities:—

EUROPE—Pomerania, Stettin; Lithuania, Lake Switez (*Dybowski* in Woloszczak, Fl. Polon. exsicc. no. 783).

The second specimen gives an interesting south-eastern extension of the species.

NORTH AMERICA—Labrador (*Lamaric-Picquot* in Herb. Paris); Buffalo (*Clinton*); Chicago (*Taylor*); Long Island (*Miller*); Pennsylvania (*Bischoff*).

Var. ROBUSTA, Morong, in Coult. Bot. Gaz. x. (1885) 255, et in Mem. Torr. Bot. Club, iii. no. 2 (1893), 60; Rendle in Trans. Linn. Soc. ser. 2, Bot. v. 404 (1899).

I had not seen specimens of this variety when my revision was published, and suggested that it might perhaps be a form of *N. microdon*, A. Br. Through the kindness of Professor Trelease I have just received two small specimens from Morong's Herbarium now at the Missouri Botanical Garden. They were collected at Pine Lake, Clinton Co., Michigan, and have every appearance of a robust form of *N. flexilis.*

I should describe the leaves, which are strongly ascending, as linear-tapering rather than simply linear. The specimens are sterile, as stated by Morong.

9. NAJAS MICRODON, A. Br. in Sitzungsb. Ges. Naturf. Fr. Berlin, 1868, 17; Rendle in Trans. Linn. Soc. ser. 2, Bot. v. 405 (1899).

I have noted the following additional localities:—

NORTH AMERICA—Nebraska (*Rydberg*, no. 1786); Missouri, St. Louis; Fossés de l'Ohio (*Lesquereux* in Herb. Boissier).

WEST INDIES—St. Domingo (*Bertero* in Herb. Paris, *Poiteau* in Herb. Delessert).

SOUTH AMERICA—French Guiana (*Leprieur* in Herb. Paris); Venezuela, "Laguna Puriæ bei Victoria" (*Karsten* in Herb. Mus. Palat. Vindob.); "locis fl. Amaz. stagnantibus, Ega" (*Poppig* in Herb. Mus. Palat. Vindob.).

13. NAJAS CONFERTA, A. Br. in Sitzungsber. Ges. Naturf. Fr. Berlin, 1868, 17; Rendle in Trans. Linn. Soc. ser. 2, Bot. v. 409 (1899).

Additional locality:—

FRENCH GUIANA—(*Leprieur*).

14. Najas arguta, H. B. K. Nov. Gen. et Sp. i. 371 (1815); Rendle in Trans. Linn. Soc. ser. 2, Bot. v. 410 (1899).

Evidently a widely distributed tropical South-American species, at present known from the east coast and from the north-west, but doubtless to be found elsewhere. The following gives the distribution according to present knowledge:—

Brazil—Ad oram meridionalem flum. Amazonum, ad ostium flum. Solimoes (*Spruce*, no. 1622); Ilhios (near the coast at 15° lat.) (*Martius*).

Colombia—Near Mompox (River Magdalena) (*H. B. K. l. c.*); La Paila (*Holton*); (*Lobb*).

Ecuador—Guayaquil River (*Jameson*, no. 544).

§ 3. *Euvaginatæ.*

15. Najas minor, All. Fl. Pedem. ii. 221 (1785); Rendle in Trans. Linn. Soc. ser. 2, Bot. v. 410 (1899).

The following notes are of interest for the distribution of the species:—

North Germany—Menz bei Rheinsberg, Tiefer Nemitz See (*Magnus*); Parsteiner See bei Angermünde (*Magnus*).

Professor Schinz tells me that it is a rare plant in Switzerland.

South-east Russia—Mouth of the Volga, numerous localities (*Korshinsky*).

A fine series recently received by the Department of Botany from the Botanic Museum, St. Petersburg, and remarkable for showing a wide variation in habit in plants collected within a small area. Besides the more typical form with the tufted dichotomous habit and rigidulous recurved leaves are forms showing varying degrees of laxity, expressed by elongation of the upper internodes and less rigidulous recurved leaves; in one form the leaves are suberect and quite straight, hanging limply together.

Accompanying the increase in laxity we find diminution in size and prominence of the leaf-teeth, which in the extreme form become inconspicuous. The character of the fruit is, however, remarkably constant throughout the series.

Egypt—Riziares du Delta (Herb. Richard); Cairo and Chonbrah (*Sickenberger* in Herb. Boissier).

Tropical Africa—Emin Pasha Expedition (*Schweinfurth*, no. 4242).

Algeria—Oued (river) Boudjima (*Cosson*, no. 1185); Ouebera (*Durieu* in Herb. Cosson); Senhadja (*Perraudière* in Herb. Cosson).

Tunis—Ad basin Djebel Schkeul (*Letourneux* in Herb. Cosson).

Japan—In Herb. Drake del Castillo, labelled "Tanighémo" no. 471 (? *Faurie*).

19. Najas Kingii, Rendle in Trans. Linn. Soc. ser. 2, Bot. v. 416 (1899).

This species was described from a unique specimen collected by Sir George King in South Andaman.

Its range is extended in the following specimens, which I saw in the Berlin Herbarium:—

Tonkin—Mares des environs de Hanoi (*Balansa*, no. 4651).

Singapore—(Schlesisch. botan. Tauschver. no. 528).

21. Najas foveolata, A. Br. apud Magnus, Beitr. p. vii (1870); Rendle in Trans. Linn. Soc. ser. 2, Bot. v. 417 (1899).

Japan—The presence of the species in Japan has hitherto been doubtful, depending on a fragment, with young flowers, collected by Miquel. I have, however, seen in the Paris Herbarium a specimen from Yokoska, "in oryzetis inundatis" (*Savatier*, no. 1348), which undoubtedly belongs; also a doubtful specimen without fruit in Herb. Drake del Castillo (*Faurie* ?, no. 470, named "fatsaumo"). A third specimen, also without fruit, but which I have very little doubt belongs to the species, was collected at Yokohama (*Naumann*).

24. Najas tenuifolia, R. Br. Prodr. 345 (1810); Rendle in Trans. Linn. Soc. ser. 2, Bot. v. 419 (1899).

I have seen the following additional specimens. The extension of the range from North and East Australia to New Caledonia is of interest:—

Australia—Port Denison, Queensland (*Mueller* in Herb. Magnus).

New Caledonia—Houailou (*Grunow* in Herb. Mus. Palat. Vindob.).

28. Najas setacea, Rendle in Trans. Linn. Soc. ser. 2, Bot. v. 422 (1899).

The locality for this species is Mauritius, not Bourbon as previously stated. A. Braun received the plant from Mougeot without the collector's name. In Richard's Herbarium, now in the possession of M. Drake del Castillo, is a specimen labelled Isle de France, Neraud.

29. Najas horrida, A. Br. apud Magnus, Beitr. pp. vii, 46, 47 (1870); Rendle in Trans. Linn. Soc. ser. 2, Bot. v. 423 (1899).

Of this species, hitherto known only from Tropical Africa, there is in Herb. Cosson a specimen from Algeria:—La Calle, Rivisteau au lac Houbera (*Durieu*).

§ 4. *Nudæ.*

31. Najas graminea, Del. Fl. Aeg. 282, t. 50. fig. 3 (1812); Rendle in Trans. Linn. Soc. ser. 2, Bot. v. 424 (1899).

Of the following additional specimens the most interesting are those by which the range of this widely distributed tropical Old-World species is extended to Western North Africa and New Caledonia:—

Algeria—Senhadja, Lac Freitis (*Letourneux, Perraudière*).

Egypt—Damanhur and Rosetta (*Letourneux* in Herb. Cosson); El Khargeh, Gr. Oase (*Schweinfurth*, no. 620 in Herb. Cosson).

Nubia—Djur-land, Kutschuk Ali Seriba (*Schweinfurth*, no. 1217).

Syria—Syria littorali (*Gaillardet*, no. 2246 in Herb. Boissier).

Luzon—(*Digaman* in Herb. Magnus).

New Caledonia—Mares d'eaux douces situées sur les bords de la rivière d'Ourai, près de la Baie Lebris (*Balansa*, no. 1713 in Herb. Paris).

Australia—Murray River, New South Wales (*Mueller* in Herb. Magnus).

Species dubiæ vel excludendæ.

Najas effugita, Heer, Flor. tert. Helvet. i. 103, t. 46. figs. 3 *a* & 3 *b* (1854–55); Schimper and Schenk, Handb. Palæont. Abth. ii. 381 (1890).

"*N.* fructibus minoribus lanceolatis, stylo brevissimo, stigmatibus duobus elongatis.

"Oeningen, Insektenschicht des untern Bruches."

Not seen.

The figures represent a fruit which is 9 mm. long to the tips of the stigmas, 4·5 mm. to their point of separation, and 3 mm. broad. It may belong to *N. marina*, Linn. Heer suggests a similarity to *N. minor*, All., but it is larger than any fruit of this species which I have seen.

Najas striata, Heer in K. Svensk. Vetensk.-Akad. Handl. viii. no. 7, 52, t. 8. figs. 5, 6 (1870); Schimper and Schenk, Handb. Palæont. Abth. ii. 381 (1890).

"*N.* fructibus ovato-lanceolatis, longitudinaliter striatis, stylo longiusculo."

Kingsbai, Spitzbergen.

Not seen.

The specimens consist of narrow, linear, striated pieces of stem and an ovate-lanceolate fruit, which is 7 mm. long by 2·5 mm. broad . . . . with well-marked longitudinal striations and a cross-line at the insertion of the solitary style. Only one stigma is present. The author says: "It is very similar to *Najas stylosa*, Heer, but distinguished by the longitudinally striated fruit. The fruit closely resembles in form that of *N. flexilis*, which also has a long style, but it is much larger and not smooth."

I do not think that any of the specimens belong to the genus.

Najas stylosa, Heer, Flor. tert. Helvet. i. 103, t. 46. figs. 1 & 2 (1854–55); Schimper and Schenk, Handb. Palæont. Abth. ii. 381 (1890).

"*N.* fructibus ovato-lanceolatis, stylo longiusculo, stigmatibus duobus elongatis.

"Oeningen, Insektenschicht des untern Bruches."

Not seen.

Fig. 1 represents a stem bearing leaves, and probably does not belong to the genus. Fig. 2 represents an axillary fruit with a pair of stigmas, and measures nearly 1 cm. in length to the tops of the stigmas and 8 mm. to their point of separation. If it is a species of *Najas*, the large size of the fruit precludes all except *N. marina*, Linn.

The determination of these species, which assume the existence of *Najas* in Tertiary times, seems extremely doubtful.

LINNEAN SOCIETY OF LONDON.

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THE COMPARATIVE ANATOMY OF CERTAIN SPECIES OF ENCEPHALARTOS, LEHM.

BY

W. C. WORSDELL, F.L.S.

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October 1900.

XIV. *The Comparative Anatomy of certain Species of* Encephalartos, *Lehm.* *By* W. C. Worsdell, *F.L.S.*

(Plate XLIII.)

Read 16th November, 1899.

THERE may be said to be two types of structure prevailing in the stems of the Cycadaceæ—viz., the one in which there occurs a single vascular cylinder, as in the majority of Dicotyledons; the other in which there is more than one cylinder, often as many as a dozen. There are three genera which present this last type of structure, viz., *Cycas*, *Macrozamia*, and *Encephalartos*. Of these, the first two have already been worked out and described in detail; the third, although the main features of its structure have been superficially touched upon and referred to, has yet to be treated in the same way as the others have been. This detailed account of the structure I propose giving in the following pages.

Historical Survey.

Mohl * in his paper, "Ueber den Bau des Cycadeenstammes," shortly describes the structure of *Encephalartos* under the generic name of "*Zamia*." He distinctly mentions the occurrence of the medullary system of bundles, and states that of a second vascular cylinder there are only very inconspicuous traces. The species described by him under the old generic name were *Encephalartos latifolia* and *E. horrida*.

Miquel's monograph † includes many species of *Encephalartos*, but, naturally, very little information as to the anatomical structure is given.

Mettenius ‡, in his excellent work on Cycadean anatomy, treats briefly of the principal features of the stem-structure of *Encephalartos*, as also of *Cycas*, *Dioon*, and *Zamia muricata*.

Encephalartos caffer, Lehm.

General Structure.

Having obtained from Mr. Wm. Bull, of Chelsea, an old plant of *Encephalartos caffer*, Lehm., with a stem about 9 inches in diameter, I was enabled to carefully investigate its anatomical structure and to compare it with that of *Cycas* and *Macrozamia*. I have found the structure to be extremely similar to that of the latter genus—so similar, in

* Abhandl. der königl. bay. Akad. zu München, i. 1832, pp. 397–442; republished and revised in 'Vermischte Schriften,' 1845, pp. 195–211.

† Monographia Cycadearum, 1842.

‡ "Beiträge zur Anatomie der Cycadeen," Abhandl. der königl. sächs. Gesellsch. der Wiss. vii. 1861, pp. 565–609.

fact, that it appears surprising that the plants should be placed by systematists in distinct genera. In view, therefore, of this fact, it will not be necessary to describe the structure of this plant in any great detail.

The main features of this structure are, as in *Macrozamia Fraseri*, Miq., the possession of a wide pith, traversed by an anastomosing system of vascular bundles and mucilage-canals; a number (4 or 5) of vascular cylinders extremely broken up by medullary rays, so as to be composed of distinct wedge-shaped segments, often widely separated from each other; a thick cortex, traversed by innumerable leaf-trace bundles, and bounded on its outer periphery by the leaf-bases.

I will now proceed to briefly describe the structure in the different regions of the stem, restricting my remarks to those points only in which the structure differs from that of *Macrozamia Fraseri*, Miq.

Cortex.

There is as yet, in this plant, no sign of any formation of periderm at the periphery of the cortex cutting off the leaf-bases; the tissue of these latter is still fresh and directly continuous with that of the cortex.

The mass of tracheides, constituting a large bulk of each girdle-leaf-trace bundle, possess reticulate, but never or rarely spiral thickenings, and thus do not present so great a resemblance to protoxylem as is the case in *Macrozamia Fraseri*, Miq.*. The rest of the secondary tracheides on the lower side of each girdle-trace, which may form a considerable thickness of the bundle, possess scalariform pittings on their walls, which may either extend the whole way across the wall, so as to present the appearance of a close spiral, or may form several rows of short pits as in the Ferns (Pl. XLIII. fig. 1).

The Vascular Zones.

In the lower part of the stem about *five* distinct zones or cylinders of vascular tissue are observed (fig. 2); thus rather more than in *Macrozamia Fraseri*, Miq. These in the upper and younger part of the stem dwindle to two zones. Here and there large segments or bundles can be seen lying, apparently quite out of place and somewhat obliquely, between any two of the rings (fig. 2); these constitute the connections between the successive vascular rings—a function which cannot be discerned from an examination of a single transverse section alone, but can be readily made out from a series of such, as also from a radial section (fig. 3); in the ordinary cross-section these strands appear merely as irregularly-placed segments of the rings. In describing the structure of the *Macrozamia* I omitted to draw attention to their presence, as they were much less obvious in that plant.

Fig. 2 is a diagrammatic view of a portion of a transverse section of an unknown species of *Encephalartos* from the collection in the large Kew Museum, and affords an excellent illustration of the general type of vascular structure of this genus as described above.

* Worsdell, "The Anatomy of the Stem of *Macrozamia* compared with that of other Genera of the Cycadeæ," Ann. Bot. vol. x. 1896.

Throughout the stem and, at least in the upper portion, in more than one of the zones, the younger sieve-tubes of the phloem exhibit on their oblique terminal or radial walls, as seen in transverse section, distinct traces of callus on the sieve-plates, stained with a watery solution of aniline blue, although this substance appears to be much less frequently present in the lower and older than in the upper and younger part of the stem.

Although the character is one found also in *Macrozamia*, I consider it important to state that the curious, irregularly-shaped tracheides described in that plant and in *Cycas* also occur here, scattered amongst the cells of the ground-tissue and the sclerides, *on the inner side of the xylem between two successive vascular rings.* These tracheides I regard as homologous with the tracheides occupying the centre of the concentric vascular strands in the cortex of the stem and root of *Cycas*, and of those strands which constitute the chief vascular structure of the Medulloseæ.

Owing to the early obliteration of the protoxylem elements as seen in the case of the innermost vascular zone, no criterion must be sought from the (apparent) absence or presence of protoxylem in the outer zones as to the primary or secondary origin of the latter. This important point can only be satisfactorily settled by reference to the upper part of the stem near the apex, where the second vascular zone can clearly be observed to originate in cambial divisions arising from the parenchymatous tissue immediately outside the phloem of the primary vascular zone, and which Costantin and Morot determined to be the pericycle *.

A point which was not observed in *Macrozamia* is the fact that the cambiums of most of the vascular zones appear to be all active at the same time, for, in at least three or four out of the five zones, narrow and extremely thin-walled cells, with very conspicuous nuclei, were observed, both cell-walls and nuclei staining deeply with hæmatoxylin. This seems to point to the fact that the cambiums of the older zones, as that of each successive new zone arises, do not cease to be functional (at least in this instance), as has been stated to be the case by various authors for other plants, but rather that new elements are added to all or most of the zones simultaneously for a prolonged period.

An important and, indeed, the only apparent difference between the structure of the stem of this genus and that of the stem of *Macrozamia Fraseri*, Miq., is the absence, or apparent absence, in the former of the highly interesting tertiary strands with inverted orientation, whose character and homologies were fully discussed in my former paper. Although careful search was made, I could detect absolutely no trace of any such structure in this stem. This does not, however, preclude the possibility of their being present in some other species ; and it is quite probable that they would not be found in all species of *Macrozamia*.

In the larger meshes of the network exhibited by a tangential section of the phloem of any of the vascular zones are seen the leaf-trace bundles accompanied always by a mucilage-canal, the latter passing right through to the pith, for there is a *continuous system* of these mucilage-canals throughout the entire parenchymatous system of the

* Bulletin de la Société Botanique de France, xxxii. 1885, pp. 173–175.

plant. The individuality of the leaf-trace bundle is destroyed soon after it enters the xylem of the innermost zone, for it here gives off connections during its inward course to the strands of this tissue, so that a complete transversely-sectioned bundle is not usually observed in the larger meshes of the xylem-network as is the case in the phloem.

The Pith.

The individual bundles forming the complex *medullary vascular system* are similar in form to the segments composing the vascular zones (fig. 4); those in the lower part of the stem are, naturally, by far the largest and equal in size to those segments, consisting almost entirely of secondary xylem and phloem, with a few small, irregularly-placed, reticulate tracheides, which represent the primary xylem of these bundles. Several radial rows of vascular tissue may be formed around a mucilage-canal separated by rows of parenchyma-cells which represent medullary rays (fig. 6).

Mohl * states that the medullary bundles of *Encephalartos* pass through the medullary rays and become connected in the cortex with the leaf-trace bundles. This statement, however, as I have been careful to determine, is an erroneous one. The medullary bundles constitute a vascular system quite independent of that of the leaf-traces. They penetrate the inner vascular zone by the medullary rays (fig. 7), their tracheides uniting with the similar elements of that zone (fig. 8). This latter diagrammatic figure illustrates remarkably well the point above referred to, for a leaf-trace bundle from the cortex is here shown fusing with the same vascular zone and in close proximity to the point of fusion of the medullary bundle, but, it is to be noticed, quite independently of the latter. Fig. 7 represents a tangential section of the xylem of the inner vascular zone with a medullary bundle lying obliquely in the ray and about to fuse with the adjoining strands; a mucilage-canal is seen to be accompanying the bundle.

Structure of the Roots.

The original primary tap-root of the plant had completely died away, and had been succeeded by a number of *adventitious* roots springing from the flattened and partially decayed lower end of the stem.

It appears that these plants, which grow in clefts of rocks in the hilly country of South Africa, have, at a certain season of the year, to endure a dry season, during which their tap-root entirely dies away, along with, presumably, the foliage. During this period the stem, swollen as it is with its massive parenchymatous tissues and protected externally by the thick and coriaceous leaf-bases, probably acts as a water-reservoir by means of the network of mucilage-canals penetrating every part of the organ, the mucilaginous secretion serving to retain every particle of moisture previously absorbed by the root, and thus to preserve the stem from desiccation. It seems to me that this is a very probable explanation of the presence of such a vast system of mucilage-secreting canals in the stems of Cycads. It is a significant fact in this connection that *the roots are*

* Vermischte Schriften, 1845, p. 200

entirely devoid of mucilage-canals. At the end of the dry season adventitious roots are emitted by the stem, fresh leaves are put forth, and growth proceeds as before.

A transverse section through the upper and thickest portion of one of the adventitious roots, close to its junction with the stem, exhibits a very thick cylinder of xylem enclosing a fairly wide pith; the phloem is very much narrower than the xylem and the inner contour of the xylem is almost circular, and I could not discern how many protoxylem-groups were present. Great numbers of sclerotic cells occur in all the parenchymatous tissues and in the phloem. *Mucilage-cells are absent.*

The most interesting feature of the root is the presence, immediately outside the large cylinder, of one or two smaller cylinders or concentric strands, which are possibly not entirely closed on their inner side. Their elements are extremely irregular in position and course, many of the segments composing them running tangentially instead of vertically. Each encloses a pith containing great numbers of sclerotic cells. They are probably entirely secondary in origin, and are doubtless homologous with the similar strands occurring in the roots of *Cycas revoluta* *, Thunb. They fuse with the main cylinder lower down, and thus occur only in the upper and oldest part of the root where it adjoins the stem.

In one thick root examined the pith of the large cylinder is full of tracheides, contorted and involuted in every conceivable direction. They appear to be merely tracheides of the inner part of the xylem, which has, for some strange reason, assumed this unwonted and anomalous course in the pith.

Younger roots are triarch and diarch in structure.

ENCEPHALARTOS HORRIDUS, Lehm.

I examined a plant of this species from the Palm-house at Kew, having an axis 4–6 inches in thickness.

The central cylinder of the stem gradually narrows in diameter as it passes down into the *tap-root*, which in this specimen is preserved. Considerable irregularity prevails in the setting and position of the tissues in the lower region of the stem. On one side of the cylinder, in the transitional region between stem and root, and immediately on its outer periphery, as seen in transverse section, occurs a large vascular strand with a great amount of xylem and phloem, all probably of secondary origin (fig. 9, cs^1). This strand evinces a tendency towards a *concentric* structure. It is perfectly similar to and homologous with the semi-concentric strands situated on the periphery of the central cylinder, which some time ago I noted in the transitional region between root and stem of a small plant of *Macrozamia Denisonii*, F. Muell., as also with the similar strands in the same region in *Cycas revoluta*, Thunb. Like those in the latter plants, the strand under consideration has connections with the central cylinder. On the dorsal side of, and closely abutting on, this large strand occur at one level two other smaller ones of the ordinary collateral structure and orientation (cs^2). At another level two strands are seen, one on each side of the large one, each with a considerable amount of

* Worsdell, "The Comparative Anatomy of certain Genera of the Cycadaceæ," Journ. Linn. Soc., Bot. vol. xxxiii. 1898, p. 440, pl. 20. fig. 5.

secondary thickening, one of which has *inverted orientation*, *i. e.*, with its xylem directed *outwards*, and which, if traced to another level, is seen to fuse with the central cylinder. The strand on the other side eventually fuses with the large semi-concentric one. Further out in the cortex are scattered other much smaller bundles with *inverted orientation* (*cs*[3]). Another group of three bundles was observed, with *their xylems mutually directed towards each other* (*cs*[4]).

All these smaller strands I regard, with the larger one above described, as being cauline in origin, both on account of their peculiar orientation and grouping, and the fact that no leaf-bundles exhibiting the normal orientation and course are present in the cortex of this transitional region, but only first make their appearance at a higher level.

All these cauline strands are found only in this transitional region between stem and root, and are both above and below this region no longer to be met with. The great importance of this point will be fully dealt with later on. The large strand is, as in *Macrozamia Denisonii*, F. Muell., probably continuous in both directions with the central cylinder, as also, in all likelihood, is the case with the smaller normally-orientated strands immediately abutting on its dorsal side. But, unfortunately, not one of these strands was distinctly traced throughout its whole course.

At the same level at which these cortical cauline strands appear, the central cylinder at one point exhibits a most peculiar anomaly, inasmuch as it there undergoes a curious invagination, so that an arc of bundles, all more or less intimately united laterally, is seen projecting into the pith.

An outer vascular zone has not yet arisen in this stem similar to that in the last species. But there cannot be much doubt that the strands above described represent the first beginning, although on one side of the stem only, of the outer vascular zones, each strand representing in reality a single segment of a whole ring.

At a somewhat higher level the leaf-trace bundles appear in the cortex, so that it is possible, what could not be certainly made out from the structure of the central cylinder, that the region below this level belongs to the root rather than to the stem, although mucilage-canals are there present both in pith and cortex, and medullary bundles are also abundant.

The tap-root is exceedingly thick and swollen in one portion of its length, so that the xylem becomes broken up by the expanding parenchymatous tissues into a large number of scattered fragments.

Encephalartos lanuginosus, Lehm.

One out of a number of lateral branches arising low down on the stem beneath the level of the soil was afforded me for investigation. The plant, for the branch had become independent by developing a thick adventitious root simulating very closely both in position and structure a primary tap-root, has about the same thickness of stem as the last species described.

The lower part of the stem, which has a very much less diameter than the major portion, shows, as regards development of vascular tissue, a very great advance on

E. horridus, Lehm. Three or four vascular zones, greatly divided up into distinct segments in places and very irregular in position, are already formed. The pith in the lowest part of the stem is extremely small in area, and traversed by strands running across from one part of the cylinder to the other. Higher up in the stem only two vascular zones are present; the origin of the second one, from cambial divisions taking place in the parenchyma 8 or 10 layers of cells away from the first zone, is very clearly seen in the uppermost part of the stem.

Medullary bundles and mucilage-canals are very sparse in this plant, at least at this stage of its development.

A curious concentric grouping of bundles in the cortex was observed in one transverse section from the lower part of the stem, reminding one of a similar case seen in the cortex of the stem of *Macrozamia Fraseri*, Miq., and of the concentric grouping of the leaf-trace bundles in the Medulloseæ.

In some of the radial sections of the vascular zones the large, reticulate tracheides resembling transfusion-tissue are very clearly recognized amongst the parenchyma-cells between the two zones.

Structure of the Root.

The thick adventitious root has a structure which is, doubtless, quite similar to that which the primary tap-root would have presented had it been present. Developed around a small pith are two very thick vascular zones. At one point, immediately on the outer periphery of the second zone, is a thick strand of secondary tissue, curved slightly inwards at each end, similar, although not so far advanced towards the concentric structure, as the large cortical strand described above for *E. horridus*, Lehm. Thus we find here the same structure as in the transitional region between stem and root in *E. horridus*, Lehm., with the exception that in the latter one vascular zone instead of two is developed.

The structure of an adventitious branch of *E. Altensteinii*, Lehm., was also examined, but as it reveals nothing fresh, but exhibits essentially the same structure as that of *E. lanuginosus*, Lehm., a separate description thereof is not deemed necessary.

Summary and General Conclusions.

The following are the chief results, with the conclusions I formulate therefrom, which accrue from the comparative investigation of the above species of *Encephalartos*:—

1. The structure of the vegetative organs, consisting of stem, leaf, and root, of the four species of *Encephalartos* is in almost all respects similar to that of the two species of *Macrozamia*, viz., *M. Fraseri*, Miq., and *M. Denisonii*, F. Muell., already investigated by me.

The difference in the reproductive organs between the two genera, upon which systematists have hitherto founded their classification, appears to me to consist of quite

minor points, the most essential characters being common to the two genera. This fact, taken together with the intimate agreement of the two in their vegetative structure, seems to me to be strongly in favour of the future union of these two genera into a single one by systematists.

I may here remark that the Cycadaceæ afford a striking instance of a case where the anatomy, even more in some instances than the reproductive parts, may afford an important basis for classification, not only with regard to the different genera amongst themselves, but with regard also to living plants of other groups, and especially to fossil forms.

2. The occurrence in three of the species examined of more than one vascular ring, as is the case in *Cycas* and *Macrozamia*. My specimen of one of these species is a plant many years of age; the others are adventitious branches of very old plants; all possess adventitious roots only.

3. The fourth species (*E. horridus*, Lehm.), a seedling plant still retaining its primary tap-root, exhibits as yet but a single vascular ring. But in the transitional region between stem and root occur a single large cauline strand and several smaller ones, such as have been described in the main part of the paper above. With regard to these vascular strands I would here adduce the following considerations:—

a. The plant exhibiting this structure, with its primary tap-root still retained, must necessarily be at a much younger stage of development than any of the other three species.

b. This being so, it is quite natural to find the outer vascular rings as yet undeveloped. But I hold that the large vascular strand cs^1 and the much smaller ones cs^2 of fig. 10 represent the first sporadic and local beginnings of the second and third vascular rings respectively. At a later stage of growth cambial divisions would extend all round and give rise to the second and third rings in their entirety.

c. I have stated that the small *inverted* tertiary strands of *Macrozamia Fraseri*, Miq., are absent or indistinguishable in *Encephalartos caffer*, Lehm. This is true. But in *E. horridus*, Lehm., there exist strands with inverted orientation, of which cs^3, fig. 10, is an example. This small isolated bundle I regard as a representative of part of the *fourth* vascular ring and perfectly homologous with the inverted strands belonging to the vascular rings in *Macrozamia Fraseri*, Miq.

4. The large, irregularly-shaped, reticulately-thickened tracheides occur, as in *Macrozamia* and *Cycas*, between the xylem of an outer and the phloem of the next inner vascular ring. They are the first-formed, probably secondary tracheides of the former, and may be considered as homologous with the reticulate tracheides occupying the central region of the cortical concentric strands of the stem and root of *Cycas*. I may here add, with regard to these elements, some observations on the first origin of the vascular tissues outside the central cylinder or stele, as noticed in a young stem of *Cycas revoluta*, Thunb., where the second vascular ring was making its earliest appearance, and in the upper hypocotyledonary portion of the primary tap-root of a seedling of the same plant, where one of the small concentric strands was becoming differentiated immediately outside the central stele. In both these cases it was observed that the first-

formed vascular elements arose by tangential division of the large, rounded or angular, cortical or pericyclic cells, resulting in the large, isodiametric, irregularly-shaped tracheides of precisely similar shape to those cells. After one or more of such elements have been cut off, the parenchyma-cells begin to divide radially as well as tangentially, in this way forming smaller and smaller elements with each centrifugal division, until at length the majority of the tracheides are of the same size and shape as those of the central cylinder or stele. The large first-formed tracheides very soon become displaced owing to the pressure of surrounding tissues. This fact, together with that of the great difference in size between these and the later-formed tracheides, renders the determination of their mode of origin, at an older stage of the same vascular tissues, utterly obscure. The similar reticulate tracheides in the cortical concentric strands, more distant from the central cylinder in the stem of *Cycas*, in all probability arise in precisely the same way, but, in that case, I did not succeed in definitely determining their mode of origin.

5. The cambium of several of the vascular zones is, judging from the appearance presented by its cells, simultaneously active.

6. All the secondary tracheides of the leaf-trace bundles possess dense spiral or, more probably, scalariform thickenings, thus differing somewhat from the leaf-traces of *Macrozamia Fraseri*, Miq., where only a certain number of the secondary tracheides are spirally thickened.

7. A *medullary* system of bundles occurs in all four species, similar in every respect to that of *Macrozamia Fraseri*, Miq. This system is intimately connected with a similarly-anastomosing network of mucilage-canals which is continuous with that of the cortex. The medullary vascular system is, however, quite independent of the leaf-trace system of the cortex. The bundles are *primary* in origin.

Although the presence of a medullary vascular system would appear, so far as one can judge from the examination of but four species, to be universal in the genus *Encephalartos*, the same cannot be said of *Macrozamia*, for no trace of such a system could be detected in the stems of either *M. Denisonii*, F. Muell., or *M. spiralis*, Miq., although it is possible that the latter plant was at rather too young a stage of growth to be able to exhibit the structure.

8. When the plant, growing in its native habitat, has reached a certain age, the primary tap-root dies away as the dry season approaches. The mucilage-canal system then probably acts as a water-reservoir. Next season adventitious roots arise. These exhibit in their upper and older portion a structure similar in many respects to that of the primary root of *E. horridus*, Lehm., viz., either one or two vascular rings and one or more semi-concentric cortical strands.

Finally, after the above observations on the extremely interesting structures in the vegetative organs of *Encephalartos*, I should like, before concluding the paper, to bring forward some considerations with regard to the phylogenetic relationships of the Cycadaceæ, suggested by the contemplation of the various structures in this genus.

In the first place, I wish to restate the generalization made or inferred in my account of the anatomy of *Macrozamia Fraseri*, Miq., viz., that the stem-structure (as also, of course, that of the upper portion of the root) is in all probability derived from the

structure of the same parts in fossil plants identical with or closely allied to the Medulloseæ. The formation of the successive vascular rings would have been brought about as follows:—The original structure in the Medulloseæ "consisted," to quote my former words, "of rings or layers of concentric vascular strands. . . . As time went on, and greater specialization in the conducting-tissues arose, and a need for the formation of a larger amount of this tissue became urgent, the cambium of the inner portion of each such concentric strand gradually became less and less functional, that of the outer portion, on the contrary, more and more active, so that a much larger quantity of wood and bast became formed on the outer side of each strand than on the inner side, for this was the surest and best means of economizing both space and expenditure in the building up of an efficient conducting-tissue for the stem. The result is, finally, the structure, as we at present know it, in the stem of *Cycas*, *Encephalartos*, and *Macrozamia*."

Dr. D. H. Scott, in his extremely interesting and valuable paper on the structure of *Medullosa anglica*, holds the above view to be "fallacious," on the ground that "the primary ground-plan of the stem-structure of a polystelic *Medullosa* was fundamentally different from that of the monostelic Cycadaceæ." For myself, however, and with all deference to the authority and experience of the author just quoted, the primary ground-plan of the two structures cannot be regarded as "fundamentally different," inasmuch as I hold (which Dr. Scott does not) that in the "monostelic" genera—*Stangeria*, *Ceratozamia*, *Zamia*, *Bowenia*—there is evidence for the derivation of the central cylinder of the stem from a ring of steles or *concentric* bundles. What I regard as a relic of the ancestral structure is here found in the most primitive cauline organ of the plant, viz., the peduncle, and consists of tracheides occurring in considerable numbers on the inner or ventral side of the protoxylem of each bundle, and, what is more remarkable still, occasionally accompanied, as was seen in the case of *Stangeria*, by phloem on the *inner* side of these tracheides, *i. e.*, on the side nearest the centre of the peduncle. Once or twice an entire bundle, with inverted orientation, was observed on the ventral side of, and in close proximity to, one of the bundles of the cylinder. This centripetal xylem of the central cylinder of the peduncle of the four genera mentioned was first discovered by D. H. Scott, and has been carefully and minutely described by him in a valuable paper*.

The curved, in some cases almost horseshoe-shaped, in one or two cases perfectly *concentric*, contour of the bundles composing the cylinder in the lower part of the peduncle at once suggests the idea of their derivation from concentric bundles or steles. The same may also be said of the bundles of the cylinder in the *axis* of the male cone of *Ceratozamia mexicana*, Brongn. †, and *C. latifolia*, Miq. ‡. Here also occurs another piece of evidence for the Medullosean ancestry of these plants, in the form of *concentric* and collateral bundles in the pith of the same size as the bundles of the cylinder, as also much smaller collateral ones of inconstant orientation. That all these bundles are vestiges of an ancestral condition is shown by their inconstant structure

* Scott, Ann. Bot. vol. xi. 1897, p. 403.

† Thibout, Recherches sur l'Appareil Mâle des Gymnospermes, 1896.

‡ Worsdell, Ann. Bot. vol. xii. 1898, p. 232.

and orientation and their more or less rudimentary development. Scott's explanation of the centripetal xylem in the peduncle of *Stangeria* is that it is a vestige of a structure such as occurs normally in the vegetative stem of such fossil plants as *Lyginodendron* and *Calamopitys Saturni*, Ung., and he parallels the occasional occurrence in *Stangeria* of internal phloem and entire inverted bundles with the case of Seward's *Lyginodendron robustum*, where vascular tissue with inverted orientation also occurs on the inner side of the primary xylem, as it also occasionally does in *L. Oldhamium*. The comparison thus instituted I should distinctly support. But, on the other hand, I regard the vascular tissues with inverted orientation, which occur regularly in *L. robustum*, Sew., and irregularly in *L. Oldhamium*, not as sportive and utterly abnormal, but as a reversion to the typical ancestral condition. That the vascular stem-structure of *Lyginodendron* is really composed of the vestiges of a ring of *concentrically-constructed* strands is distinctly shown, as in the peduncle of *Stangeria*, by the *curved contour* of the bundles composing the cylinder in *L. Oldhamium*. I am very far from regarding the stem-structure of this plant (like Scott does) as derived from that of *Heterangium*, this latter being, with its single large stele, really a variant on that of *Medullosa* with its ring of several steles, just as is also the case with *Colpoxylon*, which latter plant may, in fact, be regarded as a *Medullosa* possessing one or two large steles or concentric strands instead of a number of small ones. Such forms as *Heterangium* are not necessarily the most primitive; a *polystelic* member of the Cycado-filices, *Cladoxylon*, is found at a geological horizon quite as low as that at which *Heterangium* occurs. The latter plant probably represents a distinct phylum of development. *Lyginodendron* more nearly resembles the typical Medulloseæ and existing Cycads, its structure consisting, as in both these groups, of a ring of steles or vestiges of such. Its ancestors never had primary tracheides occupying the so-called "pith."

Scott says again :—" Extrafascicular zones occur in the same form in some Medulloseæ as in certain recent Cycads, so it appears unnecessary to derive this part of the structure from a reduced system of rings." But this part of his argument carries but little weight, for it appears almost certain (is, at least, highly probable, in view of the *transitional structures* found in other species of *Medullosa*) that the structure referred to has itself been derived from the definite polystelic arrangement of its own more internal strands and of those of the more typical forms.

I may add that valuable evidence for the origin of the stem-structure of Cycads from that of the Medulloseæ has been observed in the *roots* of several genera—e. g., *Cycas revoluta*, Thunb., *C. Seemanni*, A. Br., *Encephalartos* (described above), and *Macrozamia*,—viz., in the upper or hypocotyledonary part of the organ near the transitional region between stem and root. I would draw very special attention to the fact (for on this depends much of the weight of my whole argument) that this is the region *par excellence where the first-formed tissues are situated* and therefore *where ancestral characters would be sure to preponderate*. The vascular tissue arising outside the central stele in this region assumes the form, when it is first laid down, of, in some cases, perfectly *concentric*, in others partially *concentric, strands* or portions of such. These structures in the root *are only found in those genera with more than one vascular ring*

in the stem; the primary tap-roots of *Stangeria* and *Bowenia,* two genera with but a single vascular ring, do not exhibit these outer concentric strands, as would, in all likelihood, also be the case with *Ceratozamia, Zamia,* and *Dioon,* the remaining three genera possessing a single vascular ring in the stem. This is a fact of importance, for it points, with a fair amount of certainty, to the conclusion that *the concentric or partially concentric strands,* or the fragmentary portions of such, *situated at various radial distances outside the central root-stele, are the homologues of the second, third, or fourth vascular rings in the stem.* And it is probable that, at a later stage of growth, the place of these strands would be occupied by a vascular ring of collateral structure, when the inner portion of each strand would become displaced and isolated as small bundles with inverted orientation of their parts, such as were shown by me to exist in the lower portion of the stem of *Macrozamia Fraseri,* Miq.

Pl. XLIII., fig. 9, I regard as of extreme importance in helping materially to substantiate the views I have put forward as to the phylogenetic origin of the successive vascular rings of Cycads, for it presents within small compass that which, if rightly interpreted, is, to my own mind, at least, a key and clue to the whole question. I hold, then, the significance of this structure to be as follows:—The strand cs^1 represents and is homologous with the second vascular ring of the higher regions of the axis, but it retains (and this is the important point) almost the entire contour of the *primitive concentric constituent* of the ring; the two bundles cs^2 represent two *concentric* strands of the third vascular ring (of which, in each case, all but one of the *outer* segments, exhibiting, of course, the orientation of the first ring or central cylinder, have become obsolete); in the same way the fourth vascular ring has for one of its representatives at this level of the axis the bundle cs^3, the sole remnant of a *concentric* strand whose *innermost* segment has alone survived. It is highly illustrative of what I have been endeavouring to point out with regard to the meaning and origin of these cortical strands, that cs^4, at the same distance in the cortex from the central cylinder as cs^3, affords what I regard as an example of one of these concentric strands which has, happily, retained in more perfect form than the rest its primitive structure. Its parts are, it is true, rather loosely connected together and isolated, thus giving this strand the appearance of a group of bundles rather than of a single one; but it should be remembered that this loose aggregation of the segments is one of the chief and peculiar characters of Cycadean vascular strands. Fig. cs^4 also probably represents, along with cs^3, one of the primitive constituents of what, in the ancestors of the plant, would have constituted a *ring of small concentric strands.*

The fact that, as in the case of *Encephalartos horridus,* Lehm., and *Cycas revoluta,* Thunb., the concentric strands, or parts of such, in the root are local in their occurrence —appearing sometimes, as in the first-named plant, at one point only of the periphery of the central stele—the greater portion of the subsequent vascular ring being constructed according to the ordinary collateral plan, may be explained by the fact that these ancient types of structure are gradually becoming obsolete and extinct, that they represent, in truth, the last sporadic rudiments of a once dominant *concentric* type of structure, which

is now at length yielding to, and has almost become suppressed by, the modern and more efficient collateral type. In the *later-formed* vascular tissues of the axis, *i. e.*, those in regions other than the transitional one between stem and root, the collateral has entirely superseded the concentric plan of structure, and as such is laid down from the earliest stage onward *all round* the periphery of the central ring.

With regard to the "accessory vascular strands" described by Scott as occurring in the cortex outside the group of steles in the stem of *Medullosa anglica*, and figured in plate 5, photograph 4, and in plate 12, fig. 18, of his paper, I fully incline to agree with the author that they are probably "comparable to the cortical bundles of *Cycas* . . . . or to the irregular strands which sometimes occur in the extrafascicular region of *Macrozamia*." But I go further, and say that these accessory strands are homologous, not only with those of *Cycas* and *Macrozamia* mentioned, but, I would add, with those of *Encephalartos horridus*, Lehm., as seen in fig. 9, and therefore, according to my own view, with the successive vascular rings in the stem of *Cycas*, *Macrozamia*, *Encephalartos*, and the Medulloseæ. It is exceedingly interesting to note that these "accessory strands" contain in their central parenchymatous portion the same short reticulate tracheides as I have described for the vascular strands of *Cycas*, *Encephalartos*, and *Macrozamia*. This is a point of much importance. Scott says:—"We know . . . . that some Medulloseæ (e. g. *M. stellata*, var. *gigantea*) formed successive extrafascicular zones of wood and bast outside their stelar system, just as we find in *Cycas*, *Macrozamia*, and *Encephalartos* at the present day. It is therefore not surprising that in our species we should meet with other characteristic Cycadean anomalies." Little wonder, indeed, if, as I believe, these "other anomalies" are entirely homologous with the former ones. The author says further:—"The accessory strands in *M. anglica* are certainly quite different from the normal steles and leaf-traces; neither can they be identified with the strands supplying adventitious roots, which had a more horizontal course. There is no indication of their connection with any other form of lateral appendage." All quite true. But the explanation which I have given of these structures, especially after comparing them with the cortical vascular strands of *Encephalartos horridus*, Lehm., exhibited in fig. 9, will alone avail to save the unsatisfactory process of relegating these "accessory strands" to the category of undefined "anomalous" structures.

The term "anomalous" I hold, moreover, to be inappropriate, as applied to the "extrafascicular" rings of vascular tissue in the three genera of Cycads and certain species of *Medullosa*, for it implies that these structures cannot be classified and defined like the other structures of the order, a supposition which, as I have above tried to show, is false. I hold that there is nothing "anomalous" in these strands, but that they constitute part of the morphologically-inherent structure which has for long ages been characteristic of the group in which they are found. They are thus fundamentally different in nature from the structures, more or less similar in appearance, occurring in the stem and root respectively of such plants as *Tecoma* and *Beta*, which are purely adaptive in character, *i. e.*, have been specially adopted, within a comparatively recent period, to suit the special physiological necessities of the plants in which they occur.

My final conclusion, then, is as follows:—The vascular tissues of the stems of existing Cycads have been derived, with modifications corresponding to the period which has intervened, from the vascular tissues of the stems of the Medulloseæ or plants with closely-allied structure, and along the following lines: the central cylinder of our modern plants is the direct derivative of the primary ring of concentric strands or steles of the fossil forms, while the succeeding secondary vascular rings of the three Cycadean genera which possess them, and the secondary concentric or partially concentric strands, or parts of such, which occur in the cortex of these three plants, have had their origin in the successive outer rings of the Medulloseæ, which (although this point has not yet been definitely ascertained) will probably be eventually proved to be also secondary in origin; for secondary structures can only derive descent from secondary structures and not from primary. Therefore all the secondary vascular tissues of modern Cycadean stems constitute part of the inherent morphological structure, and in this respect differ completely from, and should never be compared with, the secondary extrafascicular structures of such plants as the Sapindaceæ, *Tecoma*, and *Beta*, which, as already stated above, are purely adaptive in character and have been assumed for purposes of nutrition.

In conclusion, I have to thank the authorities of the Royal Gardens, Kew, for so kindly furnishing me with much of the valuable material for this investigation.

EXPLANATION OF PLATE XLIII.

The following are the abbreviations used:—

ph = phloem; nx^2 = normal tracheides of the secondary wood; px^2 = reticulately-thickened tracheides of the secondary wood; *px* = protoxylem; *lb* = leaf-base; *ltb* = leaf-trace bundle; *ct* = cortex; *g* = girdles; *p* = pith; *mb* = medullary bundles; *x* = xylem; *mr* = medullary ray; vr^1 = first vascular ring; vr^2 = second vascular ring; vr^3 = third vascular ring; vr^4 = fourth vascular ring; *mc* = mucilage-canal; cs^1, cs^2, cs^3, cs^4 = cortical strands representing the successive vascular rings.

Encephalartos caffer, Lehm.

Fig. 1. Radial section of a girdle-leaf-trace bundle. × 130.

Fig. 3. Diagram of a radial section, showing a connecting strand between two vascular rings.

Fig. 4. Transverse section of a large medullary bundle from the lower region of the stem. × 35.

Fig. 5. Transverse section of a young medullary bundle and mucilage-canal. × 130.

Fig. 7. Tangential section of the xylem of the first vascular ring, showing a medullary bundle and mucilage-canal in the medullary ray. × 35.

Fig. 8. Diagram of a radial section of the first vascular ring, showing the connection with the xylem of a medullary and a leaf-trace bundle.

Encephalartos Altensteinii, Lehm.

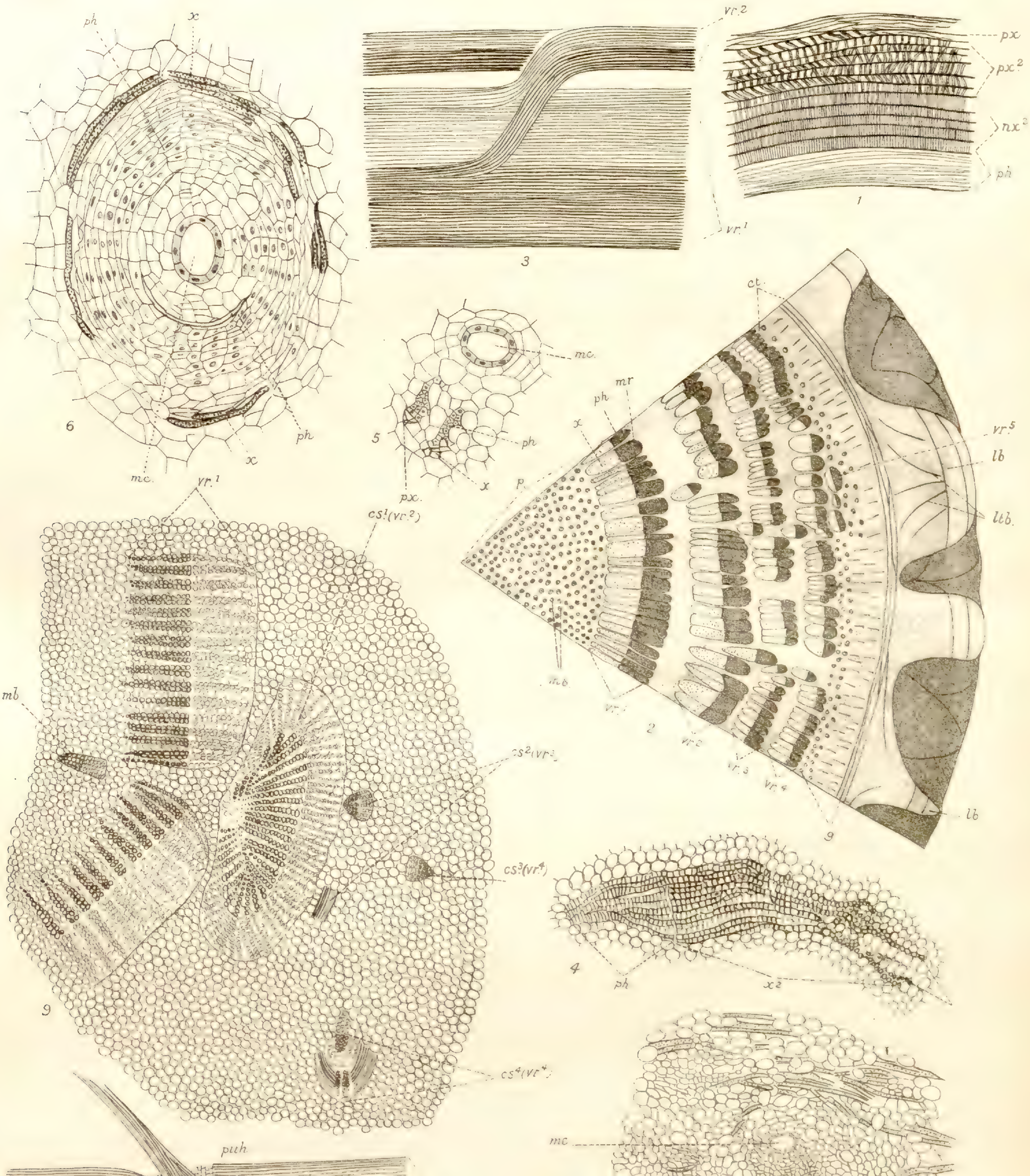
Fig. 6. Transverse section of a mucilage-canal in the pith, surrounded by bundles. ×35.

Encephalartos horridus, Lehm.

Fig. 9. Diagram of a transverse section of a small part of the vascular ring from the transitional region between stem and root, showing a series of more or less primitively-constructed strands in the cortex, which represent the successive vascular rings of the higher part of the stem; also a medullary bundle.

Encephalartos sp.

Fig. 2. Segment of a transverse section of the stem, showing the general structure, viz. medullary bundles, vascular rings, and leaf-trace bundles. Nat. size.



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[NOTE.—Ordinal and Tribal Names are printed in SMALL CAPITALS: Accepted Names of Genera and Species in Roman; Synonyms and Native Names in *Italic* type; an asterisk denotes first publication.

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